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Gas vs. Electricity for Cooking.

[Prepared by R. C. POWELL, for the 22nd Convention, Pacific Coast Association.]

During the last three or four years there has been considerable effort put forth by manufacturers of electric devices, and to some extent by electric central stations, towards an extensive introduction of electricity into the heating field. Large numbers of heating devices have been sold and are being sold, principally irons, toasters, percolators, soldering-irons, etc. Comparitively few ranges have been put out, although a few fireless cookers and bake ovens have been introduced.

Recently manufacturers of electric ranges have become active and are putting out an excellent appliance. They have been installed in a number of United States battleships, and according to reports are giving excellent results. In this service their use is principally baking, since boiled foods are cooked with steam. It must be remembered, however, that the saving in space of electric ovens over the coal fired type is an item of no mean importance aboard ship, and electricity is generated very cheaply—1 cent, or less, per kwh. The success of electric cooking for marine service is of no moment to us in the present discussion, and I mention it only to bring before you one of the latest achievments of electricity.

In England, electric cooking and heating have made considerable progress, and there seems to have been more agitation and discussion among the central station men there than here. This may appear strange, in view of the fact that England is a country in which there is high gas consumption, and where the electric central station industry has not been developed to a point comparable with our own. Electric appliances have to some extent been put out by English central stations on a rental basis. In Germany, also, there is increasing interest regarding etectric heating. Electric cooking and heating has always been an interesting question to the electrical man, because to him it represents a field as yet unconquered, and to this extent, electricity "is still in its infancy."

In coming before you with this paper, I assume that the growing use of electric heating devices has at least stirred up some interest in the gas man, if it has not brought him to the point of wondering what the effect is to be upon his business. I hope what I have to say will interest you, and I shall attempt to attack the question from the impartial view point of one connected with a company manufacturing and distributing very extensively both these would-be competitors. If electricity is to compete with gas on a large scale it will, of course, be necessary to deliver electric power to the consumer at such a price that the net result in service and cost will be approximately that of gas. These results depend upon (1) the efficiency of the consumer's appliance, (2) the cost per cubic foot for gas, or per kilowatthour for electricity delivered at the meter. The claims made by manufacturers of electric ranges are greater cleanliness and freedom from disagreeable products of combustion, high efficiency and less loss of weight in cooking.

I have not been able to find much reliable data regarding the efficiency of either gas or electric cooking and heating, most of the figures given being apparently estimates or mere guesses. Before the Institution of Electrical Engineers (England) in 1911, Mr. Harold Gray reported some experiments with gas and electric cooking. He evaporated 1 pound of water at various rates of burning, and from his figures I find an efficiency of 32.5 per cent. at 3 cubic feet per hour to 38.8 per cent. at 10 cubic feet per hour with gas of 600 B. T. U. Evaporating water with electricity he obtained 91 per cent. with a "self-contained 1 pint sauce pan," using a hot plate with aluminum utensil 65.2 per cent., and with an earthen ware pot 62.4 per cent. The mean for electric cooking gives an efficiency of 75 per cent. With a gas oven of 6,400 cubic inches, 8 pounds of bread were baked in 58 minutes with 31 cubic feet of gas; 9 pounds of bread were baked in an electric oven of 6,137 cubic inches in 52 minutes consuming 0.92 kw. hours. With gas at 90 cents per 1,000 and electricity at 4 cents per kw. hour, the cost per pound of bread would be approximately equal. It may be interesting to note that in England the rates used in discussions of this character are about 60 cents for gas and 2 cents for electricity. In 1913, Mr. T. P. Wilmshurst, in a paper on "The Commercial Aspect of Electric Cooking and Heating," dealt with the loss of weight in cooking and with the heating of water. With various kinds of meats he found the average loss of weight to be: coal range, 34 per cent.; gas, 23 per cent.; and electric, 11 per cent. His data on water heating appears to have been estimated, and he allows the following: coal, 10 per cent.; gas, 50 per cent.; and electricity, 90 per cent. He also mentions a test on a "Belling electric geyser" which gave over 97 per cent. efficiency. Most writers on the subject give for coal and coke an efficiency of 2 to 10 per cent.; gas, 12 to 15 per cent.; and electricity, 80 to 90 per cent. These are usually electrical men, and I am afraid they have overestimated the efficiency of their own appliances and underestimated that of gas. With some tests of my own, I found electric hot plates (3 types) to vary from 22 per cent. to 45 per cent. efficiency; gas (assumed 600 B.T.U.) 35 per cent. efficiency when heating water in an aluminum

kettle holding about 1½ gallons, and water heated on an electric range of latest type, 62 per cent. From Mr. Gray's and my own experiments, I believe the all around efficiency of gas is at least 25 per cent. and electricity not over 75 per cent.

When converted into heat, 1 kw. hour gives 3,412 B.T.U.'s, and if we assume electricity to be used at 75 per cent. efficiency, 60 kw. hours will give the same useful heating as 1,000 cubic feet of gas of 600 B. T. U.'s at 25.6 per cent. of efficiency. Hence, on a basis of cost for useful fuel we have:

Gas at			Electricity at		
$0.75	per M.	equals	1.25	cents	per K.W.H.
0.90	"	"	1.50	"	"
1.00	"	"	1.67	"	"
1.25	"	"	2.08	"	"
1.50	"	"	2.50	"	"
1.75	"	"	2.92	"	"
2.00	"	"	3.33	"	"
2.25	"	"	3.75	"	"
2.50	"	"	4.17	"	"

Now gas, in some places, is sold for 75 cents per M., but there is not much electricity being distributed for ordinary cooking purposes at 1½ cents per kw. hour, or anything near it. Electricity for heating purposes is, however, sold at 3 and 4 cents in communities where gas could not be sold profitably at $1.75 per M. Hence, in the smaller towns and country district the electric cooking and heating business should develop to considerable proportions, particularly where hydro-electric power is cheap and fuel high. For some irrigation projects electric plants have been built and the power transmitted for pumping. In winter, since there is no pumping, the plants are practically idle, and during this season electric current can be produced so cheaply as to be able to compete with almost any other fuel. A number of such plants have thus quite a heating and cooking load, but these like the application of electricity for heating in marine service, while sure to greatly increase are under special conditions and not much of a factor as a competitor of gas.

In the large cities where gas is distributed, electricity is sold at from 6 to 10 cents or more in the residence districts where most of the gas is consumed. Here in California the prevailing rate is 7 cents, and the rate for cooking and heating about 3 or 4 cents, sliding perhaps to 1.5 cents after about $10 or $12 worth for the ordinary range has been consumed at the higher rate—which means the rate is practically 3 or 4 cents. These are low rates for electricity; in fact, electricity in many parts of California is extremely cheap, and electric men doubtless feel they have in some cases more than reached bottom.

Some electrical men are very enthusiastic over the possibilities of electric cooking, the man with ranges to sell seeing a market for millions of his appliances, and the central station man an enormous demand for his produst. In order to develop this business against gas competition it is, of course, necessary to offer a very low rate for electricity. The central station is tempted to do this since there seems to be a belief that the taking-on of a large cooking load will so much improve the load factor as to ultimately return a good profit, and make up the loss he must sustain in developing the business. We shall show the fallacy of this later on.

First of all, let us see how much heat we really receive in either a cubic foot of gas or a kilowatthour of electricity. By insulating the electric appliance against loss of heat we can approach more or less closely to 100 per cent. efficiency. With gas, however, it is not possible to approach the theoretical so closely with a simple appliance, on account of the heat lost in the products of combustion. This waste heat is, (1) that required to raise the gas and air to the temperature of the products of combustion amounting to 8 to 10 per cent. (2) the latent heat in the water vapor formed in burning the hydrogen of the gas, and which cannot be recovered in any appliance operating at, or above, the temperature of boiling water. This latent heat is 7 or 8 per cent. for gas containing 50 per cent. hydrogen. Therefore the highest efficiency we can theoretically attain with ordinary gas for cooking purposes is about 85 per cent. Thus, 600 B.T.U. gas has a possible net value of approximately 500 B.T.U.'s. Hence, at a 4 cent electric rate, the consumer has delivered at his meter 853 B. T. U.'s for 1 cent. At a 90 cent gas rate he receives 500,000 B. T. U.'s per M. or 5,556 B. T. U.'s for 1 cent. That is, the gas man delivers to him for 1 cent, 6.5 times as much (what we might term theoretically usable) heat as the electric.

Since the profits in each case are about the same, gas manufacture must be fundamentally more efficient than electric generation, either from the physical or capital standpoint, or both. If the current happens to be generated by an oil burning steam plant, we may readily compare the physical efficiency of manufacture of electricity and gas, by taking ratios of heat energy in finished and raw material, since there are no bi products in the electric plant and none of much consequence in the oil gas plant. If it takes nine gallons of oil to make a thousand cubic feet of gas and 10 per cent. is lost in distribution, the net efficiency is 37.5 per cent. The very best steam electric plants could scarcely have a yearly efficiency of over 10 per cent. from oil barrel to switchboard and 80 per cent. efficiency of distribution is high, so the physical efficiency of manufacture and distribution would not be greater than 8 per cent.

Now, if we return to our original figures of 25 per cent. and 75 per cent. efficiencies for gas and electricity used, we find physical efficiencies of 11 per cent. and 6 per cent. for gas and electricity, respectively. Hence, oil gas manufacturing has roughly, twice the efficiency of that for electricity as applied for cooking purposes. If we have hydro-electric power the efficiency from water to cooking utensil would vary from about 25 per cent. to 45 per cent. depending upon size of plant, length of transmission and general efficiency.

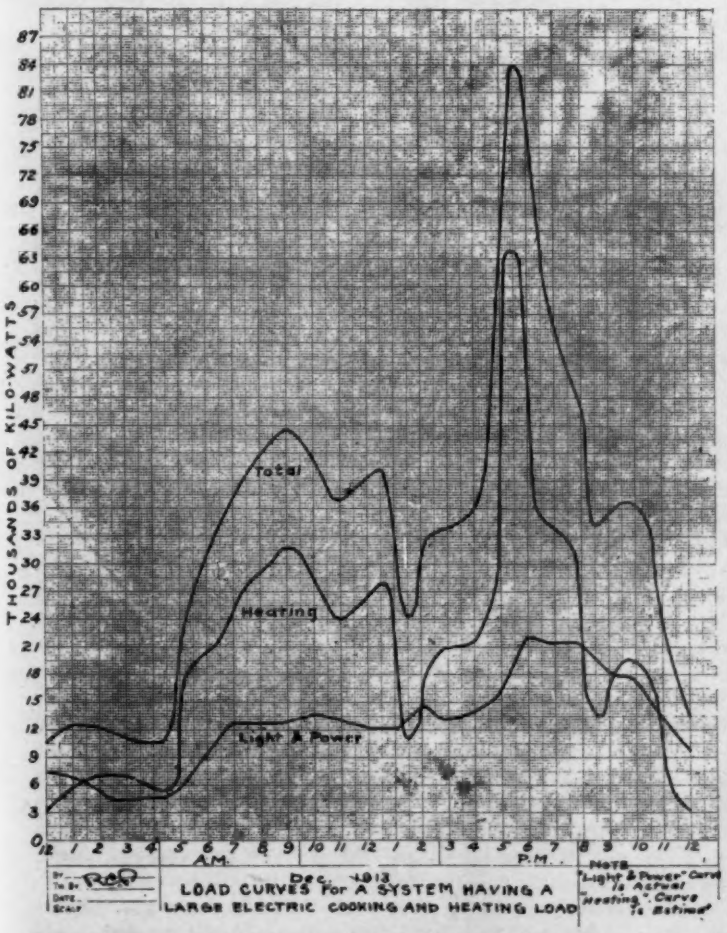
Besides the raw material wasted, which we have just expressed in the term physical efficiency, the cost of manufacture depends upon the efficiencies of capital and of operating expenses. By the efficiency of capital, I mean the cubic feet of gas, or kwh. electricity that can be manufactured and distributed per unit of capital invested. This efficiency is, of course, only relative, because we have no value to represent 100 per cent. To compare the capital efficiencies of gas and electric plants we will find it convenient to express the capacity and output of the gas plant in electrical units, which, of course, amounts to determining the size and cost of an electric system designed to displace a gas system. There is no commercially successful means of storing electricity on a large scale in any way comparable with a gas holder, so that at any instant the electric plant cannot generate power in excess of that taken by the consumers, plus the losses; the plant must increase and decrease its output to suit the varying demands with no storage of any kind to fall back upon. The electric plant is therefore rated according to its maximum rate of turning out energy, whereas a gas plant is rated according to the amount of gas it manufactures in a given time, for example in a day. However, the gas actually taken by the consumers varies from hour to hour during the day, and unless the generating and distributing system is large enough we can conceive of their being such a great demand over a period of say, one hour, that there would be a tremendous drop in pressure, and at the end of the hour, if the demand were severe enough, many consumers, if not all, would be unable to obtain any gas whatever. It is, therefore, not altogether illogical to rate the gas plant in terms of thousands of cubic feet per hour, which will then come pretty close to the idea of an electric plant of so many kilowatts. For we can assume the output from the gas plant over this hour to be uniform and we have seen that 1,000 cubic feet of gas are equivalent for cooking purposes to 60 K.W.H., or with 10 per cent. loss to 54 K.W.H. delivered. Hence, we may replace our gas plant by an electric one having a capacity of 54 K.W.H., plus electrical losses for each 1,000 cubic feet maximum hourly output.

A large gas generating and distributing system will cost approximately $5,000 per 1,000 cubic feet maximum hourly generating capacity. The cost of an electric system to do the same work for the same capital would have to be $92.50 per kilowatt demand at the meter. Thus a gas system costing $92.50 per unit will carry the same cooking and heating load as a steam electric system costing $250 per unit, or an hydro-electric system at $450 per unit. That is, the gas system capital efficiency is about 2½ times that for the steam electric system and nearly 5 times that for the hydro-electric. The preceding takes into account the assumed efficiencies of the appli ance. If we neglect these and consider only the theoretically usable h eat, we find that for each 1,000 B.T.U. per hour capacity, the gas system requires $10 capital, the steam electric $73, and the hydro electric $130, or the relative efficiencies are as 1 to 7 to 13.

While the manufacture and use of gas is, as all of our processes for utilizing natural heat resources, notoriously wasteful, it is a great conserver of these natural resources compared with steam electric transformation as applied to cooking. The opposite is, of course, true for the hydro-electric system. But we see the cost is so great as to preclude it from competition with gas excepting in special cases, and until either the price of oil goes up considerable or the cost of developing water power and building distributing systems is lowered.

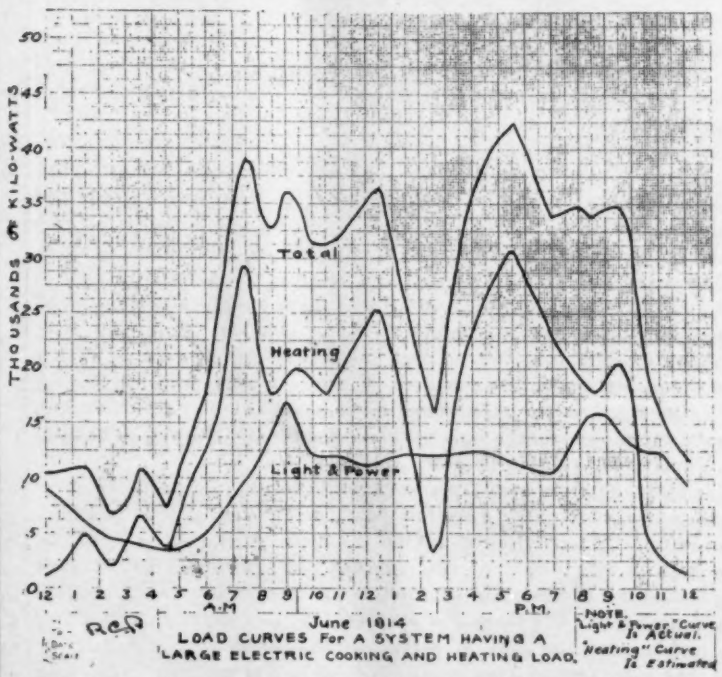
Operating cost efficiency we know is lower for gas than for electricity—not so much interest, depreciation, maintenance or operating labor per unit as delivered or used.

We have yet one other point to consider. The capital invested in electric systems is very large and hence the capital costs, interest, depreciation, etc., are a large portion of the total operating costs, particularly in the case of hydro electric power. Therefore, we must keep our equipment as busy as possible. Now, we have a term called the load factor which tells us how busy our electric plant was during a given time. It is the ratio of the actual kw. hours generated to the number which could have been generated had the plant been loaded to full capacity. This varies from about 25 per cent. yearly load factor for a medium sized plant with a small power load, to 40 per cent. for cities like Chicago. The yearly load factor for the Pacific Gas and Electric Company is 60 per cent. for the whole system, and a similar company operating in Los Angeles and vicinity has a factor somewhat higher. Not very many systems, however, reach even 50 per cent. The more consumers we connect and the more diversified the use to which they put electric service, the better becomes the load factor. But if their maximum demands for power all come at the same time the load factor is not improved much.


THOUSANDS OF KILO-WATTS
Total
Heating
Light & Power
A.M.
P.M.
Dec. 1913
LOAD CURVES For A SYSTEM HAVING A LARGE ELECTRIC COOKING AND HEATING LOAD
NOTE. "Light & Power" Curve Is Actual. "Heating" Curve Is Estimated

Because people do cooking in the day time, and there are obviously a great many prospective consumers in this field, some of the electric men reason that the load factor would be so improved as to greatly reduce the cost of electric power, since the equipment would be kept busier, as it were, and thus the investment charges reduced. However, the facts of the case investigated by the writer are, that the yearly cooking and heating peak is simultaneous with the light and power peak, and the addition of a large cooking and heating load would really reduce instead of increase the yearly load factor.

For a gas plant supplying a territory of several hundred thousand inhabitants, I obtained the hourly output for each hour of a day in December judged to have the maximum hour. These hourly outputs I reduced to equivalent kilowatt capacity and thus obtained the load curve which an electric plant would have if the gas plant were done away with, and all the gas cooking and heating done by electricity. I have also plotted in the same way the present total electrical load for approximately the same territory. I show you these for 2 days—one in December, with the typical winter load, and one in June, representative of the summer load. Observe the sharp peaks of the heating load, particularly in December. You will also see another interesting thing, namely: that the heating peak comes between 5 and 6 P.M. in summer as in winter, whereas the light and power peak comes about 6 P.M. in winter and about 8:30 in summer, due to the heavy lighting load shifting according to time of sunset. The power load, that between 7 A.M. and 6 P.M., is practically the same during the year, but during these hours the heating curves show the present gas load to be much greater for winter than summer. The daily load factor for the three December curves are: Light and power, 59 per cent.; heating, 33 per cent., and total, 40 per cent.


THOUSANDS OF KILO-WATTS
Total
Heating
Light & Power
A.M.
P.M.
June 1914
LOAD CURVES For A SYSTEM HAVING A LARGE ELECTRIC COOKING AND HEATING LOAD.
NOTE. "Light & Power" Curve Is Actual. "Heating" Curve Is Estimated

What we really are interested in, however, is the yearly load factor. From the total gas manufactured during the year, and the hourly maximum output, I have found the gas plant yearly load factor to be 29 per cent. The light and power yearly load factor for the same territory is about 50 per cent. The combined electric peak, if all the gas were to be supplanted by electric heating and cooking would be 84,000 K.W., and the yearly load factor 35 per cent.

The increased production would not be able to overcome this heavy reduction in load factor so that the average price per kilowatt hour would be increased instead of being decreased. Thus since a very large electric cooking business can only be built up by a low cooking rate, rates for other classes of really more profitable business would have to be raised considerably in order to bring up the average and make the plant as a whole profitable.

Summary.—Under special conditions such as aboard ship, and where hydro-electric power is applied principally to seasonal industries like irrigation work, electricity has the field as compared to gas.

In small towns where gas cannot be sold for less than $1.75 per 1,000 cubic feet, electricity is a competitor of gas, and a very strong one. In these the electric man is justified in making a determined effort to increase his business by adding cooking devices and he should succeed.

In larger communities where gas is sold for $1 or less, electricity has not under present or prospective conditions much chance to become a competitor of gas to any appreciable extent; for the manufacture and distribution of gas rests upon a much firmer economic basis. The electric central station should not waste any effort in attempting to compete with gas for cooking where a reasonable gas rate prevails, because a community as a whole cannot, and will not, support an increase in economic loss.

Switching the Foul Box Last.

[Prepared by Mr. Howard E. Mann, for the 7th Meeting, Canadian Gas Association.]

Several years ago the writer found it necessary to increase the purifying capacity of eight 25 x 25 x 5 feet deep purifiers. At that time the scheme of reversing the flow of gas through the purifiers had just come out, as had also the theory of placing the foul box last. The purifiers were connected in series of 2's and operated by a valve system with 20 inch connections. As the design of the building did not permit purifiers to be deepened to 10 or 12 feet, it was decided to convert the 8 purifiers into two series of 4 boxes each, and to pass

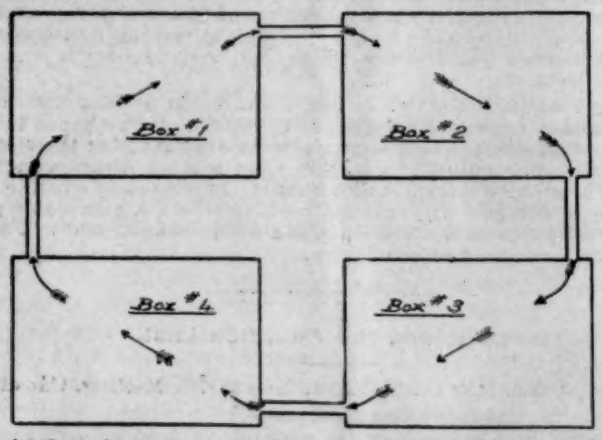
the gas down through the oxide. To convert them into down flow boxes it was only necessary to change the stand pipe from the outlet to the inlet connection; and to convert from a 2 box to a 4 box system it was necessary to make new connections between the boxes only; the main outlet and inlet headers not being disturbed.

When ready to operate, the purifiers were filled with 48 inches of new oxide in one layer. The gas passed averaged 3½ million cubic feet of coal gas per day, containing from 400 to 450 grains H_2S per 100 cubic feet. Each set of 4 boxes was passing 1,750,000 cubic feet per day. Air was admitted at exhauster outlet at the rate of 1½ per cent. of gas passed. As we had decided to adopt the theory of placing the clean box first and the foul box last, the purifiers were operated for 3 weeks before the first box was thoroughly fouled, H_2S showing slightly at the outlet of the third box.

The purifiers were put to work with No. 1 purifier as inlet and No. 4 purifier as outlet in both series. The purifiers were then switched so No. 2 became the inlet and No. 1 the outlet, or in other words the foul box was placed last in the series. Testing immediately for H_2S with acetate of lead, allowing gas to impinge upon the paper for three minutes, the gas at outlet of first box, slightly discolored it, the second and third boxes showed absolutely clean, but gas at the outlet of fourth box blackened the paper in a few seconds. Believing that presence of H_2S was due to foul gas left in purifier when switch was made, we continued purifiers in series for 30 minutes, testing continuously. As no improvement was apparent and as there was danger of gas in storage holders being fouled, we decided to cut out the last box and refill with new oxide.

The clean box was again placed first in series, and purifiers operated for two weeks before switch was made, placing foul box last. Testing for H_2S on third and fourth purifiers same results were obtained as on first test. The last purifier did not show clean or give any indication of cleaning up, though gas absolutely free from H_2S was entering it. We therefore decided that the material in the first box had become too foul to revive, although the percentage of air had been increased to 3 per cent. We again changed the oxide, and placed clean purifier first in the series. After passing gas for 3 days, testing for H_2S at last purifier a slight discoloration showed on paper, which cleaned up in less than 10 minutes, showing absolutely clean gas on a 3-minute test. It was thus conclusively proven to us that a purifier would not clean up if operated as first box for 2 or 3 weeks; it would clean up if operated for 3 days, and we therefore decided to refill purifier No. 2, as this box had been first in series while No. 1 was being refilled. Both series of 4 boxes was put to work on a 3-day schedule, and operated for 2 months before it was necessary to make any change in the system adopted. Not having catch purifiers, we were afraid that H_2S would go forward into holders during the period required for last box to clean up after switch was made. The longer the material was in use the greater the time required for last box to show free of H_2S. We therefore decided to adopt a new schedule of switches which would give us a catch purifier and eliminate any danger of H_2S being carried into holder.

The following diagram of four purifiers with illustration of the



method adopted can be used with any valve system where all four purifiers are connected. Where a center valve is used and only three purifiers working, it is possible to switch the foul box last by placing the fourth box first in series for one hour to clean up, and then switching ahead to operate with number three box the inlet and number one box the outlet for 3 day's run.

Setting the valves to make No. 1 purifier the inlet and No. 4 the outlet, gas will flow through purifiers as followers: 1—2—3—4. Operating for 3 days we found gas at outlet of No. 3 and No. 4 absolutely free of H_2S. To prevent foul gas entering holder when purifiers were switched, valves were set to make No. 4 purifier the inlet, and No. 3 the outlet in series. Gas will then flow as follows: 4—1—2—3. We now have a clean purifier first and a clean purifier last, therefore any foul gas passing forward from No. 1 will be taken up in No. 2 and No. 3, as at outlet No. 1 purifier will show clean in from 10 to 30 minutes. The next change is to place No. 1 purifier the last in series. Valves are then set to make purifier No. 2 the inlet and No. 1 the outlet in series. Gas will then flow as follows: 2—3—4—1. In 3 days purifier No. 2 will show very foul at outlet while No. 4 and No. 1 will be absolutely clean at outlet. We then switch purifiers to obtain the catch box, which is done by making No. 1 the inlet and No. 4 the outlet. In 1 hour's time the valves are switched again for the 3 days' run, and No. 3 purifier becomes the inlet and No. 2 the outlet.

Our schedule was therefore made out as follows:

Operate series for	3 days	with foul box last..... 1—2—3—4
" "	60 minutes	with catch box..... 4—1—2—3
" "	3 days	with foul box last. ..... 2—3—4—1
" "	60 minutes	with catch box .... 1—2—3—4
" "	3 days	with foul box last. ..... 3—4—1—2
" "	60 minutes	with catch box..... 2—3—4—1
" "	3 days	with foul box last..... 4—1—2—3
" "	60 minutes	with catch box. ... 3—4—1—2
" "	3 days	with foul box last..... 1—2—3—4
" "	60 minutes	with catch box..... 4—1—2—3

Switching the purifiers every 3 days as per schedule we were able to operate for 12 months before it was necessary to change the oxide.

Upon opening a purifier the oxide was found to be very hard, and it required picks and bars to break it up before we could remove oxide. Owing to the trouble experienced in removing oxide, and the increase in back pressure due to hardening, we decided to refill every 6 months. The fouled material being revivified and replaced for another 6 months' run. Testing for grains of H_2S per 100 cubic feet of gas at inlet and outlet of first box we found that an average of 95 per cent. of the H_2S was removed when clean box was placed first in series. The oxygen admitted for revivification was not taken up in first or second purifier, but passed into third and fourth box where revivification took place. This demonstrated the claim that oxygen had no affinity for sulphided oxide in the presence of H_2S. The sulphur content in oxide after 12 months' run averaged 50 per cent.

In the reconstruction of the Montreal Gas Works this system of purification was adopted and has been in successful operation on 4 25 by 35 by 5 feet deep purifiers for the past 5 years. These purifiers have a capacity as per Newbiggin's rule of 1,458,000 cubic feet per 24 hours, counting 3 boxes working and 1 box off for cleaning. We are purifying 4,000,000 cubic feet of coal gas per day on these 4 purifiers switching the valves every third day to place the foul box last, as per schedule. The only trouble we experience is back pressure caused by hardening of the oxide. It is, therefore, necessary to refill the purifiers every 4 to 6 months.

Additional retort benches will increase our coal gas production to 6,000,000 per day, and as we believe the purifiers would be damaged if we attempted to force more than 4,000,000 per day through them, the water gas purifiers will be changed over to coal gas and cylindrical steel purifiers erected for the purification of water gas. These water gas purifiers will be erected in the open and not housed. Our experience at Montreal and the other place cited demonstrated that the clean box first and the foul box last, while more than doubling the capacity of our purifiers, also enabled us to defer, in one place indefinitely, and in Montreal for 5 years, additional capital expenditure for purifying apparatus.

Catalysis in Gas Making.

[From a lecture by RUDOLF LESSING, before the North British Association of Gas Managers.]

Catalysis has been known to chemists for more than a century. The first observation of a catalytic reaction was made by Kirchhoff, in 1811, viz., that starch is transformed into dextrin and sugar under the influence of mineral acids, which latter remain unaltered thereby. But Sir Humphrey Davy's observation, in 1817, that a gently heated spiral of platinum wire becomes incandescent when placed in a mixture of air and combustible gas or vapor, the latter being at the same time slowly oxidized, has probably become the classical experiment with which the birth of the science of the catalysis is usually associated; although it was not until 1837 that Berzelius

grouped a number of these phenomena together as "catalytic" reactions, a name already known, though in an entirely different connection, to the alchemists of the seventeenth century.

The definition of catalysis commonly adopted is that given by Ostwald: "A catalytic agent, or catalyst, is a material which affects the velocity of a chemical reaction without itself appearing in the final products." This definition implies that the reaction must be possible even in the absence of the catalyst, and that the latter cannot be capable of starting, but only of acceleratiug it. Whilst this is true in theory, it is of little importance in practice, since many reactions may be possible without the catalyst, only at temperatures and pressures unattainable by our means or exceedingly slowly, or under conditions which would affect or destroy the products as soon as they are formed; whilst with the catalytic agent these reactions are brought about in reasonable time and under workable conditions. One striking feature of catalysis is that the quantity of the catalyst required is so small, and may be infinitesimal, compared with the amounts of the substances changed under its influence. From this it must, however, not be inferred that the quantity of the catalyst is quite immaterial, for in certain cases its bulk, and particularly the extent of its exposed surface, are of importance. Many theories have been advanced as to the way in which a catalyst exerts its influence. According to one commonly accepted view, a catalyst is effective because it combines chemically with some of the reacting substances to form unstable intermediate compounds which break up into the final products, the catalyst being liberated and free to combine again. According to another conception the efficiency of the catalytic agent is due to physical causes, depending on the occlusion or absorption of the reacting substances on its surfaces and in its pores. The higher concentration of the reagents thus secured is responsible for the greater velocity of reaction.

The catalytic agent may be a gas or vapor, a liquid or a solid, and is not restricted in its composition to any particular class of substances. Examples for these varities are the nitric oxides in the chamber process of sulphuric acid manufacture, the traces of water vapor necessary for the explosion of gas and air mixtures, the liquid acids used in the inversion of cane sugar, the platinum in Davy's experiment, or the iron oxide in the Claus kiln.

A vast number of processes depend on, or make use of, catalysis. It is, therefore, not surprising that we find amongst the chemical changes involved in the carbonization of coal and the working up of its products, many which are either wholly dependent upon catalytic action, or for whose mysterious complexity catalysis offers a feasible, if not the only, explanation. Even in the operation of mining catalytic influences can be traced. It is known that the cause of explosions in coal mines is more the coal dust suspended in the mine air than the "fire damp." In fact, such dust is capable of being ignited and of propagating explosion in the absence of an inflam mable gas mixture. The remedy suggested by British mining engineers, consists in the sprinkling of inert stone or shale dust on the surfaces of the hauling roads in the mine, which covers the combustible coal dust and renders it apparently incapable of starting or propagating explosions. In 1882 Sir Frederick Abel laid emphasis on the view that the dust "exerts a contact or catalytic action upon gas mixtures similar to that possessed by platinum." It is quite conceivable that the physical structure of combustible dust will be such as to favor the occlusion, and thereby concentration and compression, of gases on the surface, which might go so far as to induce, on slight provocation, combination of oxygen and fire damp in the case of inflammable gas mixtures, or spontaneous combustion of the coal substance, if air only is occluded, or both reactions will go side by side. The coal dust thus acts as catalyst by reason of its physical structure; it is only secondarily attacked by the heat evolved, and gives off combustible vapors by carbonization, which, in its turn, might be catalytically affected by the composition of the coal dust, and particularly as regards its mineral constituents. The heat evolved will be sufficient to propagate explosion. Similar considerations apply to spontaneous combustion of coal. The older theory, that the presence of pyrites played an important part has been practically discarded, in view of the fact that the organic matter in the coal on oxidation by atmospheric oxygen furnishes sufficient heat to explain the phenomenon of spontaneous combustion. But there is little doubt that this oxidation is largely influenced by the chemical constitution of the coal, and the mineral constituents act, probably, as catalysts in promoting or inhibiting oxidation.

If we admit that coal is subject to catalytic influences at ordinary temperature, when it is chemically almost at rest, and when it is only in contact with air or traces of gas which one would not expect to react with it to an appreciable extent, how much more must those influences assert themselves when coal is raised to temperatures so high that its molecules suffer destruction, that the bonds of affinity between its components are severed. It does not require a great deal of imagination to see that the conditions under which coal is carbonized, and the complexity of the coal substance itself offer great possibilities for catalytic reactions.

The very vessels in which carbonization takes place are of materials which, under the circumstances, must act as catalytic agents. We know that the primary products from coal suffer decomposition on coming in contact with the heated wall of the retort or with the incandesence coke. Now, all thermal decompositions of organic substances must be grouped in two classes: (1) Those produced by the action of heat alone; (2) those produced by heat, but necessitating or accelerated by the presence of some foreign substance with which the vapors come in contact, and which acts as a catalyst. The deposition of carbon on the retort walls is largely the result of such a contact decomposition. Now, if the retort walls are capable of favoring such a reaction, it is reasonable to expect that the amount of decomposition and the direction in which it proceeds must be influenced by the physical structure and the chemical composition of the material of the retorts. Glazed retorts would probably show a different behavior in this respect from unglazed ones, quite apart from the question of permeability to gas. Further, it is quite probable that the chemical composition has some bearing; and in this connection it would be interesting to compare silica retorts with those of highly aluminous fire-clay, and with iron retorts. There is bound to be some difference in the catalytic effect of these, unless all theoretical work on the influence of catalysts on pyrogenetic reactions is inapplicable to practical working. It must, of course, be borne in mind, that in ordinary practice the retort surface is partially covered by carbon, except immediately after "scurfing;" but this carbon is a catalytic agent and induces further decomposition. The importance of the catalytic or contact action of the retort material was recognized by William Young, although not expressed in so many words. By his "radiant heat" theory he aimed, obviously, at the fixation of hydrocarbon vapors by heat in such a way that the rapidity of complete detruction was not intensified and accelerated by the catalytic influence of the retort walls.

Whilst the retort walls offer a contact surface only to the primary products of distillation as far as they are in vapor form (except where they are in direct contact with coal), the process of carbonization is more directly affected by those constituents of the coal which are capable of acting as catalysts, particularly the mineral substance. The reactions which occur in carbonization may be grouped under these headings:

(1) Oxidation.
(2) Dehydration.
(3) Thermal decomposition of heavy hydrocarbons.
(4) Formation of benzene and other ring compounds.
(5) Hydrogenation or reduction.

If we assume the "free moisture" to be driven from the coal, the first rise in temperature would tend to promote combustion, *i. e.*, "oxidation" of some coal substance by oxygen which is physically occluded or chemically bound in coal, forming carbon dioxide, carbon monoxide and some water. Some oxygen which is directly linked to hydrogen in the coal molecule is next removed by "dehydration," in form of water, which serves to dissolve the ammonia, and appears as gas liquor. The coal substance deprived of its oxygen may be regarded as a mixture of very high molecular hydrocarbons which, at the temperature the charge has reached by now, suffer "thermal decomposition" into smaller fragments, viz., gaseous hydrocarbons and hydrogen, tar vapors and coke. The gaseous hydrocarbons again unite, forming aromatic "ring compounds," such as benzene, naphthalene, etc. Some of the unsaturated hydrocarbons are "hydrogenated" by the addition of hydrogen.

These reactions must not be taken as giving a true sequence of events. In fact, most of them being reversible and overlapping each other, it is impossible, with our present means, to disentangle the threads. But they are set out as types of reactions which probably occur during carbonization; and it is remarkable that all of these types are known to be liable to catalytic influence. The catalytic material is amply furnished by the coal ash. The latter is partly inherent, and so finely divided throughout the coal that it is impossible to separate it—in part it is only mechanically admixed. But even

the latter portion combines more intimately with the coal substance proper during the period of semi-fluidity, so that it is inseparably united with the resultant coke. Granted, therefore. the required intimate contact, it remains to inquire in what directions the ash may influence carbonization catalytically. In my opinion the mineral matter plays a certain part in determining the course of decomposition a coal undergoes on carbonization.

In order to illustrate this, I need only remind you of Cooper's coal liming process. The fact that the addition of a minute quantity of mineral substance (lime) to the coal does away with stopped ascension pipes and scurfing troubles, is proof of the far reaching influence of a catalyst. And there cannot be the slightest doubt that the lime acts in this case catalytically, accelerating the primary formation of permanent gas and of tar vapors not liable to excessive decomposition down to solid carbon. Although occasional attempts have been made to investigate the composition of mineral matter in coal, our knowledge is practically restricted to its oxidized condition, that is to say, to the true ash after all combustible matter has been burned off. I need only refer to the iron contents to make it clear that this metal can never exist in coal in the form in which we usually record it in analysis, namely, ferric oxide (Fe_2O_3). Matters become still more complicated at temperatures where the mineral constituents are likely to react with each other, or with the organic coal substance. Basic oxides may combine with silica to form silicates or "slag;" silica may be reduced by hydrogen or hydrocarbons to silicon; iron pyrites, of course, will first part with some sulphur, and may then even be reduced to metallic iron of a form which would be, catalytically, particularly active. It is to be expected that some of the inorganic constituents, being very finely sub-divided amongst the coal substance, have a catalytic effect upon the decomposition of the latter which is not inferior to that exerted by the retort walls.

So far we have only considered the bearing of catalysis on the main products of carbonization. But it is not less important in connection with the nitrogen and sulphur compounds. We know, again, that by the coal-liming process the ammonia yield is increased and the formation of organic sulphur compounds diminished. Why should the addition of a minute quantity of lime bring about such a result under otherwise equal conditions? A reply can be found in researches based on a fundamental paper published in 1901 by Dr. G. T. Beilby. He established the fact that metals are capable of absorbing ammonia at elevated temperature, forming nitrides (such as Fe_4N,Cu_3N) which are easily decomposed again by steam or hydrogen. Subsequent workers occupied themselves particularly with the nitrides of silicon and aluminium. Indeed, many processes have been patented according to which such nitrides are formed with atmospheric nitrogen, yielding ammonia on decomposition with water. The fact that alterations in the composition of coal ash make a difference in the ammonia yield makes it highly probable that intermediate nitride formation has some influence in converting the nitrogen, which we must assume to be present in coal in organic combination, into ammonia, and they possibly determine also the ratio of cyanogen to ammonia. Since calalysis plays so large a part in the decomposition of sulphur compounds, as will be seen later, the same must hold good for the reaction in the reverse direction—their formation.

Catalysis in the Water Gas Process.—Similar considerations apply to the water gas process. The reactions being somewhat less complex, a good deal of exact experimental work has been carried out. L. Vignon found that the percentage of methane in the water gas can be increased by the addition of lime to the coke. The following figures give the ratio of hydrogen to methane in water gas made from coke to which varying quantities of lime had been added:

Lime Added to Coke. Per Cent.	Hydrogen. Per Cent.	Methane. Per Cent.
10	88	12
15	81	19
50	77	23

A very promising application of catalysis in connection with water gas lies in the direction of transforming the mixture of hydrogen and carbon monoxide into methane. The French chemist, Paul Sabatier, suggested, jointly with Senderens, that carbon monoxide and carbon dioxide could be "hydrogenated" to methane by means of finely divided nickel at 200° to 250° C., according to the following equations:

$$CO + 3H_2 = CH_4 + H_2O$$
$$CO_2 + 4H_2 = CH_4 + 2H_2O$$

Others took up the idea, notably Elworthy, an English engineer, and later Erdmann and Bedford, who proposed to remove the troublesome sulphur impurities in the crude gas by liquefaction. The difficulty is that the hydrogen percentage in water gas is only about one-third of the amount required by the carbon monoxide. A number of other catalysts have been investigated. If the new methods for the production of cheap hydrogen—also largely based on catalytic reactions—can be so perfected to bring this gas within the range of gasworks economics, then there is every reason to hope that, by a judicious combination of water gas and hydrogen plant, the catalytic conversion of the gas mixture into methane, a non-poisonous gas of high calorific value can be brought about at a reasonable cost. This would, at the same time, constitute a most perfect solution of the problem of how to dispose of surplus coke.

Catalysis in Purification.—If we follow the gas on its course in works practice, we come to two stages of purely physical treatment, the condensation of tar and the scrubbing out of ammonia. These operations being only indirectly dependent on chemical reactions, there is obviously little scope for catalytic influence. However, once these by-products are recovered, catalysis plays, again, an important role in their working up. The next stage is purification from H_2S. The reactions preceeding in the iron oxide purifier, although perhaps not strictly covered by the term catalysis, afford an excellent example of bringing home to the lay mind the meaning of this mysterious force. Briefly, the mechanism of purification consists in the following changes: Iron oxide combines with sulphuretted hydrogen to form iron sulphide and water vapor; iron sulphide is oxidized by air, whereby the original iron oxide is re-formed, and sulphur is liberated. The sum total of these reactions is

$$2H_2S + O_2 = 2S + H_2O.$$

But this final result was only possible by the aid of the iron oxide, which acted as the catalyst, remaining to all intents and purposes unchanged. If the two operations in the process –the fouling and revivifying—are done intermittently, the former in the box and the latter outside, then this "protracted catalysis" is enacted in two definite stages. But if revivification is done *in situ*, by air added to the gas, then the process approaches a true catalytic action. In practice, the action comes to a stop when the oxide is spent. This is simply caused by the blocking up of the surface of the oxide by so much sulphur that neither air nor sulphuretted hydrogen has access to it. If we could imagine some contrivance by which the sulphur formed were continually removed, the reaction would go on indefinitely without appreciably impairing the activity of the iron oxide.

This example might serve to illustrate what is termed the poisoning of a catalyst. Catalytic agents may be rendered sluggish or inactive by impurities. In our case the product of reaction (sulphur) acts as the catalytic poison. The common experience that the more active a catalyst, the more susceptible it is to poisoning, finds also an analogy in the purifier box; for it is well known that a very highly active oxide generally loses its avidity for sulphur much quicker than one of average activity.

The problem of the removal of the minute quantities of sulphur still in the gas in the shape of organic sulphur compounds has called forth an application of catalysis on a grand scale. The lecture recently delivered by Dr. Charles Carpenter before the Institution of Gas Engineers, furnishes the proof of the enormous possibilities offered by a judicious use of catalytic principles. The reaction upon which the process is based is expressed by the equation:

$$CS_2 + H_2 = 2H_2S + C,$$

and takes place with nickel as catalyst at about 430° C. A promising proposal for the same purpose (referred to in Dr. Carpenter's lecture) has been made by M. Guillet. His process is based on the interaction of carbon bisulphide and water, according to the equation:

$$CS_2 + 2H_2O = CO_2 + H_2S$$

brought about by iron oxide as catalyst at a temperature of only 130° C. When this process has emerged from the laboratory scale it is likely to require a very simple plant, in view of the comparitively low temperature required, and since it practically consists in keeping the ordinary purifiers at the temperature mentioned.

Catalysis and By-Products.—In the tar still the catalytic action of impurities is probably responsible for the degree of decomposition by superheating, and catalysis must be looked upon as a factor in the corrosion of the stills. The effect produced by adding a small percentage of sulphuric acid to the tar is undoubtedly a catalytic phe-

nomen, as is also the purifying effect of this acid, or other reagents, added in minute quantities for the purification of the distillates.

As an instructive example of a catalytic reaction by which a tar derivative is turned into an intermediate product for the dye-stuff industry, the oxidation of napthalene to phthalic acid by means of sulphuric acid may be quoted. The result depends upon the addition of a trace of mercury to the mixture. This discovery forms quite an episode in the history of invention, for it was made by accidentally breaking a thermometer, the mercury setting the reaction going. This process, in conjunction with the catalytic process of sulphuric acid manufacture, enabled the synthesis of indigo to become a commercial possibility.

An application that is likely to become of importance in the very near future is the methodical "cracking" and hydrogenation of hydrocarbons. The demand for motor spirit occasioned the "invention" of processes for the conversion of heavy oils into light hydrocarbons. Catylysts, such as iron or nickel, are employed in many cases. Petroleum oils are already being treated on a commercial scale and it is expected that coal tar oils will also be submitted to such processes.

The sulphate of ammonia department depends on catalytic reaction in various ways. The waste gases from the saturator are either passed through oxide of iron or burned directly for acid manufacture or treated in the Claus kiln. The latter is a typical example of a catalytic process, the reactions being practicalty those discussed in connection with the oxide purifier, viz., the oxidation of sulphuretted hydrogen to sulphur by air in contact with oxide of iron, the only difference being that it is carried out at a temperature at which the sulphur is prevented from being deposited on the catalyst.

The sulphuric acid required for sulphate making is itself a product of a catalytic reaction; for the nitrous oxides, by which sulphur dioxide is oxidized in the lead chamber, are acting as a catalyst. The "contact" process for making sulphuric anhydride and sulphuric acid of any strength means a more conscious application of catalytic principles than the old chamber process. It does away with the bulky and costly lead chambers, and brings about the oxidation of the gases from pyrites kilns by air in a confined space by the aid of platinum of iron oxide catalysts.

Two processes which may effect the ammonia maker, one as a possible outlet for the product, the other by furnishing competing quantities of the product, must not be forgotten. The first is Ostwald's process for the catalytic oxidation of pure ammonia to nitric acid, carried out with platinum as a catalyst. At first sight, there might seem to be little object in turning one form of combined nitrogen into the other, when its value as a fertilizer is only considered. But the aim is to make the chemical, and particularly the explosive, industry in Europe independent of the natural saltpetre from Chili for its much-needed supply of nitric acid. The other is the production of synthetic ammonia. For this purpose several processes have been proposed, but Haber's, already worked out on an industrial scale, is in competition with ammonia from gasworks, particularly as regards anhydrous ammonia. It consists in the direct combination of hydrogen and nitrogen in the presence of catalysts under high pressure and temperature. Osmium, uranium, tungten and tungsten carbide were originally used, but cheaper catalysts, such as iron, to which definite additions of auxiliary catalysts are made, are now employed. The difficulties of applying the process on a large scale may be realized by the fact that it is carried out at 3,000 pounds pressure and at temperatures between 500° and 600° C. The hydrogen required is made from water gas by a catalytic process.

The examples quoted prove sufficiently that catalysis has a not inconsiderable bearing on the by-products from coal distillation and one that is not inferior to the role played by it in the processes of gas manufacture proper. However, its influence is by no means at an end at the point where the gas enters the storage holder. We know, for instance, that in the holder itself, as well as in the distributing mains and services, catalysis is recognized as a factor in corrosion.

We might accompany the gas to the consumer, and inquire into cases where catalytic influences obtain amongst the innumerable modes of its application. Enticing as this task would be, I need only mention such problems as surface combustion and illumination by the incandescent mantle, both of which are influenced by, if not depending on, catalysis, to indicate how wide a range is covered by the actions of this phenomenon.

THE work of changing the present high pressure gas system of the Union Light, Heat and Power Company, Fargo, N. D., to low pressure, is nearly completed. This work will result in an improved service to customers.

Steam Heating with Coke Breeze.

In two plants recently successful attempts have been made to burn coke breeze in a new type of furnace. The success of the efforts make possible a new form of fuel economy and gives owners of high pressure plants a fuel that will burn without smoke and without their going to much trouble to change the boiler settings.

Coke breeze, customarily, is made up of particles that will pass through a three-eighths inch square hole. This allows a great percentage of particles very much smaller. The breeze on any grate presents an extremely dense fuel bed, and the difficulty is to find a grate bar upon which it can be fired, as it is prone to drop through into the ash pit.

Another difficulty is that natural draft will not pass through the dense fuel bed, and therefore forced draft is necessary. Forced draft has a tendency to cause the particles to fountain up, as it were, or to blow away. After forced draft has been playing through such a fuel bed for a short time holes are formed which permit the air to pass, and that is the end of the fire.

Another peculiarity of coke breeze is the complete absence of volatile matter or gas. That is, in the coking process, to which the coal was subjected, the gas was driven off, leaving a residue practically pure carbon. This, it long has been recognized, makes an ideal smokeless fuel if it can be burned. At the same time its peculiarities make of it a fuel which requires different treatment from that given to bituminous coal with which the average steam user is familiar. If, therefore, coke breeze can be burned by a new method, it will make an ideal smokeless fuel, in plants where it is not desired to install new boiler settings. Another peculiarity of coke breeze is that it is very high in ash; sometimes the ash content runs from 17 to 20 per cent. To the steam users breeze has certain definite advantages if it can be burned. In the first place, there are great mountains of it in various parts of the country. Coke oven owners have piled it up, in anticipation of a time arriving when some use could be made of it. Experiments have been made of briquetting it, but it is too high in ash to command a price which would warrant the cost of manufacture. Because of the great piles of it coke breeze is for sale at a very low price. It is said, for example, that the delivered price at certain plants is lower than for screenings or slack. It will store for an indefinite time without burning in the pile.

Within late years a hollow grate bar has been put upon the market which makes, according to recent tests, the use of coke breeze possible. This permits the use of practically a solid surface through which the coke breeze cannot fall into the ash pit. Forced draft is used, and in the furnace upon which the tests were made, the air openings are on 9-inch centers and are described by the manufacturers as radial oblique. The statement continues: "Instead of the air being forced vertically through the fuel bed, in the Nicholson furnace, it enters at an angle of 30°, and not only takes a longer pass through the bed, but due to the succession of angular slots, sets up a series of gyrating mixtures through the furnace." It is this gyrating motion of the air which avoids the fountaining of the breeze and permits the retention of it in place until it is burned.

The first experiment was undertaken at the South Chicago Elevator Company, where the results were very satisfactory. Better results were obtained on the second test made on May 8th, at the Oliver Hotel, at South Bend, Ind.

The report of the engineer in charge is as follows:

"The following is a report of the test made on the Nicholson furnace, at the Oliver Hotel, on May 14, 1914, using coke breeze as a fuel. The test ran from 7 A.M. to 4 P.M. The load was maintained on one 150 horse power B. & W. boiler. In addition to the regular hotel load, the engine was put into service from 8 to 9 A.M. and from 2 to 3 P.M. to determine both the overload that could be carried on the boilers and whether it could be maintained until another boiler was thrown into service. No difficulty was experienced in holding steam. The load on the boiler for the entire test averaged 36 per cent. above rating.

"The boiler developed 309-horse power during the peak of the morning load, 206 per cent. of the rated capacity; and 282-horse power during the heavy demands for steam in the afternoon, 188 per cent. of the boiler rating. These results were obtained carrying less than an average of ¼ of an inch of air pressure in the ash pit and while burning 38 pounds of breeze per square foot of grate surface per hour.

(*Continued on page 266.*)

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NEW YORK, MONDAY, OCTOBER 26, 1914.

NINTH ANNUAL MEETING, AMERICAN GAS INSTITUTE.

Members of the Institute began to reach New York Tuesday afternoon and the Registration Booth in the Hotel Astor was busy until late. Wednesday morning at the Engineering Societies Building there was another rush of arrivals, and by meeting time the total registration was more than 500.

Promptly at 10 o'clock (and "promptly" was the key to all the sessions) President Gartley called the general assembly to order (and order was another characteristic of the meeting). The formal business was started at once with reports of committees and officers in this succession: Report of Directors; Committee on Election of New Members; Committee on Securing Members; Report of Secretary and Treasurer; Finance Committee. Then with Captain McKay in the Chair, President Gartley read his address, the full text of which will be in the next issue of the JOURNAL. As with all things emanating from that very able man the address compelled the attention of all who heard it, and its recommendations cannot be neglected.

Chairman McKay appointed as Committee on President's Address, A. S. Millar, E. G. Cowdery and J. A. Norcross to report on Friday morning. Following President Gartley's resuming the Chair, the report of the Trustees Gas Educational Fund, was the order, but not read, as copies were included in the papers issued to members. Next the Committee on Nominations reported, naming (not to our surprise) E. C. Jones, for President; for Vice-Presidents, Walton Forstall and S. J. Glass; Secretary-Treasurer, Geo. G. Ramsdell; Directors, J. H. Jourdan, Charles Nettleton, J. H. Klumpp, James Ferrier and J. W. Dunbar. This list was enthusiastically received and the Secretary as instructed. cast a formal ballot for it. Mr. Jones spoke briefly of his appreciation of the honor done him, and Mr. Forstall and Mr. Klumpp expressed pleasure on their election.

President P. S. Young, of the National Commercial Gas Association, called on by Mr. Gartley, urged close co-operation by the two National associations, and the neecssity of committee work throughout the year, an annual meeting of the associations not being enough in itself.

The report of the Public Relations Committee was presented by Mr. Cortelyou and read by Mr. Klumpp. Appreciation of the very important work done by this committee, in attending various Commission meetings in an advisory capacity, was voiced by gentlemen of six or eight states in which the committee had given this assistance.

The Technical Committee reported briefly, and then Chairman Robinson of Arrangements, announced the general entertainment details. The recommendations for the Revision of Constitution, presented by Chairman Addicks, were adopted; and report on Classification of Awards, Panama-Pacific Exposition was received.

President Gartley, as Chairman of U. S. Committee of International Commission on Illumination, drew attention to the over-sea happenings that prevented any report. The report of Joint National Committee on Electrolysis was then adopted, and the reappointment of this committee recommended to the incoming president. Bureau of Information reported showing the growth of its work, and its importance was commented upon by President Gartley. Secretary Ramsdell read report of Uniform System of Accounting. The International Uniform System of Pipe Threads had, of course, little to report. Mr. Douglas reported for the Accident Prevention Committee. Mr. Tutweiler on Exhibits. Mr. Morris on Pipe Standards. Recess was then taken for lunch, and the afternoon devoted to the sessions of the Manufacturing Section and the Distribution Section.

MANUFACTURING SECTION.—Promptly at 2 P.M., the Manufacturing Section was called to order, Vice-President Wm. E. McKay presiding. The first paper considered was the report of the Committee on Refractory Materials, read by Chairman Herman Russell, and close attention was paid to this short but important paper, and it was decided to continue the work for another year with the aid of the same competent committee.

After reading a paper on "Oil Tar Separation, Recovery and Disposal," by R. E. Wyant, a splendid discussion followed, participated in by Messrs. Macbeth, Dr. Elliott, A. S. Miller, Norcross, Scott, Ramsburg and Dr. Beardsley. Each of these gentlemen had interesting things to say and the paper proved a helpful one.

The chair announced the appointment of a committee to select names for office of Vice-President for ensuing year. They presented the names of Messrs. Earnsham, Wood and R. B. Brown, and these names will go to the Nominating Committee of the Institute, who will select one of them.

Paper by F. H. Wagner on "Coal Gas Residuals—Feld Process," proved of considerable interest. A symposium of "Operating Experience Under a Calorific Standard" followed, and included remarks by Messrs. Ramsburg, Dr. Humphreys. Brown, Macbeth, Moonhead, A. S. Miller, Waring, Rice, McArthur, Norris and E. C. Jones, who declared, after relating Pacific Coast Practices, that after all the kitchen clock proved the best calorimeter, explaining that if the business man's dinner was to be ready at 6, but the lamb was not done until 6:30, it showed the B.T.U.'s were below par. One gained from these experiences, relating principally to candle power vs. heat values, that opinion and practice is pretty well divided as between the two standards. The session closed with a paper by F. H. Gilpin, on "Efficiency Relation Existing between Various Argand and Open Flame Burners." After a short discussion by Mr. C. W. Hinman, adjournment was had.

DISTRIBUTION SECTION.—President Gartley's expressed wish that the attendance at the Sections sessions would be large, was more than realized here, the capacity of the room being taxed to accommodate the 200 present when Chairman Reinicker rapped for order. The four papers on the programme were read by abstract, and all of them interestingly considered. The "Welding of High Pressure Mains" was discussed by Messrs. W. Forstall, Earnshaw, Luther, Evans, Philler, Shattuck and Keppelmann, the latter showing some views of San Francisco welding and the apparatus. "The Installation and Maintenance of Services" was discussed by Messrs. Keppelmann, Simpson, Crosten, Speller, Forstall, Terry, Vincent and others; and Mr. Hurlburt demonstrated the welding of service pipe by the Thermit Process, making a weld of 1¼ inch extra heavy pipe. "Installing, Repairing and Testing Meters by a Small Company" was read by Section Secretary Stillwell, and discussed by Messrs. Castor, Knapp, Vincent, Schaddelee, J. P. Jones and Roberts. With Mr. Vincent temporarily in the Chair, Mr. Reinicker read "The Improvement of Distribution Employees," treating of their increased value through instruction in their tasks. This also was understandingly discussed, and upon completion the sestion adjourned.

The reception tendered the President and Past-Presidents of the Institute, in the evening, at the Hotel Astor, was a brilliant function and very well attended. President and Mrs. Gartley headed those receiving, and the dancing and entertainment carried the pleasures past midnight.

Thursday Sessions.

The Manufacturing Section was opened this morning with the paper by Frank Huber on "The Operation of Inclined Retorts," before an attendance of about 200. It was splendidly received and discussed

including several written discussions by members not able to be present. A good indication of re-aroused interest in the subject.

The report of the Committee on "Progress in Carbonization Methods," was read by Chairman E. L. Spencer. This important paper was ably discussed by Messrs. Ramsburg, Gartley Congdon, Drake, De Hart, Norris and others; and, on motion, recommendations were ordered strongly presented to the incoming Board of Directors for them to establish a standard for tests.

Mr. Ramsburg's paper on "Carbonization in Bulk," held an interested audience, and he showed some splendid slides of Kopper's ovens in Leopoldau, Budapest, Berlin, and Sparrows Point, Md. At its conclusion the author received emphatic and well deserved applause.

The Chemical Section and the Accounting Section was well attended and followed their program as printed. Unfortunately the room assigned the latter was so small that not all those interested could be accommodated.

DISTRIBUTION SECTION.—The first paper was that on "Proper Specification and Inspection for Interior Gas Piping," by A. E. Turner, which called out pointed discussion; Messrs. Forstall, Hanlan, Speller, H. F. Barrett, Knapp, Vincent and Barrows participating. It was also the opinion of the Section that the appointment of a Committee on House Piping should be recommended to the incoming officers of the Institute. At this point the committee appointed to suggest names for Vice President of Distribution Section reported, naming J. D. Von Maur, C. D. Keppelmann and G. T. Macbeth.

The report on "Piping Large Buildings for Gas" was presented by Chairman O. H. Fogg, who abstracted it and commented upon it. This report is one of the most complete ever presented to the Institute on any subject, and covers a matter of very great importance. It was discussed by President-elect Jones, R. R. Young, Morris, Dutton, Norman Macbeth, Treadway and Hall, and W. R. Addicks sent a written comment. The report covered 161 pages of matter and illustrations, besides insets showing piping lay-outs, and shows more than customary committee effort.

The report on Standardization of Gas Appliances was read by Mr. Barrows and discussed by Messrs. Rogers, Hanlan, J. B. Myers, Roper, G. E. Smith for G. J. Schmidt, Grady, Shaw, Dr. Cushman, Crane, Sard, Brock and Barrows. The appliance men were particularly interested in the proposed tag for ranges built under the specifications. Dr. Cushman told of the researches on corrosion of iron and steel. The Committee of Arrangements made some announcements, and Section Chairman Reinicker declared the session adjourned.

The afternoon session of all four Sections followed their programs, and the attendance of all of them continued at record breaking figures. In the Illuminating Section, presided over by Mr. C. O. Bond, a paper by C. A. Luther, on "Installation of Gas Arcs," brought out a spirited discussion by Messrs. Stone, Conroy, Hanlan, Keppelmann and others.

The Banquet, at the Hotel Astor, was a notable gathering. President Gartley read letters of regret from Congressman I. C. Copley and Mr. Emerson McMillan, and then handed the gavel to Toastmaster R. C. Dawes, who was most happy in his introductions. Mr. Geo. B. Cortelyou was the first speaker, followed by Mr. John Gribbell and Mr. J. W. Leib, who spoke for the electric industry. At the conclusion of Mr. Leib's remarks it was resolved by a rising vote to send to Mr. Thomas A. Edison the congratulations of the Institute on the 35th Anniversary of invention by him of the incandescent electric lamp. The next speaker was Dr. A. C. Humphreys, then Mr. E. J. Wessels, and last our new President, Mr. E. C. Jones. A feature of the entertainment was the singing and playing of "I love California," and the large attendance of the ladies in the balcony upon their return from the theatre party.

Friday Session.

This morning's Institute meeting was opened with the report of Committee on President's Address, presented by Mr. A. S. Miller. It recommended that careful attention be given all the matters touched upon in the address; that larger offices be had for the Institute; and that the Institute publish reports of the decisions of the various State Public Service Commissions.

Dr. A. C. Humphreys was selected President of the International Gas Congress, he surely being the logical man. The vice-presidents will be presidents of the participating societies.

The next place of meeting is, of course, San Francisco, and the time, the week of September 27th, 1915.

Reports from the Sections was presented and their recommendations will be presented to the incoming Board of Directors. It was also recommended that a Gas Chemist's Hand Book be prepared and issued. The Committee, on awarding the Beal Medal were still unable to report. Announcement was made that the total registration was about 850; and this superlatively successful meeting was declared adjourned.

BRIEFLY TOLD.

AUTHORIZES A COMPETING MUNICIPAL PLANT.—The Public Service Commission, 2nd District, New York, has granted the application of the Village of Bath for authority to supply electric current to the public from a municipal plant as well as to furnish current for street lights and other municipal purposes. The application was opposed by the Bath Electric and Gas Light Company, at present furnishing current to private consumers in Bath, and in the opinion of William Temple Emmet, the Commissioner who heard the case, the question of permitting municipal competition with a private and previously established concern is discussed at some length. The commissioner finds in this case that competition is justified because the private company has not for a long time been able to furnish satisfactory service at satisfactory rates, and while his opinion seems to show that the granting of the present application may mean the wiping out of the private company, he finds no other alternative in the premises and expresses the thought that it would be fair for the municipality to buy out the plant of the private concern. As a result of the service supplied by the company, frequently complained of to the Public Service Commission, the village recently refused to renew its contract for street lighting with the company and began the erection of a municipal plant to supply current for this purpose. Mr. Emmet, in his opinion, points out that the village had a right to do this under the law, and that it has fulfilled the law in its various steps. The authority of the Commission is only needed when the plant does other than municipal business. He finds, however, that there is not business in Bath for the successful operation of two electric plants. Discussing this the opinion says:

"We commence the consideration of this case with the certainty staring us in the face that whether we grant the present application or not, a municipal plant is to be established in Bath. Adverse action by this commission merely means that the business of the new plant will have to be limited in the manner I have mentioned; the matter has already gone too far to make it possible, in any event, that the plant will not be established. The work of constructing the plant has been largely completed. Local public sentiment in Bath seems to have definitely chrystalized in favor of this course of action, beyond any reasonable expectation of a subsequent change. * * *

"The existing company has apparently never been able to give the people of Bath a service which was in the least degree satisfactory to them * * * In 1907, this Commission granted leave to a company called the Cittzens Electric Service Company, of Bath, to construct a plant and to exercise certain franchises which had previously been given by the village * * * In his opinion the Chairman (Chairman Stevens, in the 1907 case) laid stress upon the utterly unsatisfactory service which the company was then supplying and based his decision to permit the competing concern to enter the field on this bad service."

This bad service, Mr. Emmet finds is still the same, though there have been changes in the management of the company.

Then calling attention to the fact that no plant in Bath can succeed without both the municipal and the private business, and to the fact that the municipal plant is already in possession of the municipal business, he says that without this contract the existing company cannot hope to achieve any sort of financial prosperity, and though it may struggle along briefly it will be without profit either to itself or to the people of Bath. Refusing to condemn the new municipal plant to such failure by cutting it off from private business, Mr. Emmet says:

"No matter whether the inhabitants of Bath, in deciding to maintain a municipal plant of their own, acted wisely or foolishly, the step has been taken. The business of the municipality is already assured to the new concern, and as matters now stand the only hope that individual consumers of electricity in Bath have of enjoying good electric service in the near future seems to lie in the same direction. The hope may not be realized, but favorable action on the present application will at least make it possible under good management for the new plant to justify its existence, and prove itself a blessing in the neighborhood, while to deny this application would be to foredoom both plants to financial failure."

(*Continued from page* 263.)

"Coke breeze is a cheap smokeless fuel. It burns freely in the Nicholson furnace and will not only carry a variable load, but can be burned at high rates of combustion. At the price of $1.75 per ton paid for the test carload the cost of evaporating 1,000 pounds of water is 14.8 cents, which is the same figure as that obtained on the No. 4 Indiana screenings.

"Using coke breeze, therefore, not only eliminates the smoke but also makes cheap steam. Even should the contract price of coke breeze equal that of the screenings, the value of the breeze as a smokeless fuel will offset any additional cost in the handling of the refuse."

Boiler Room Log.

Time.	Meter Readings Cubic Feet.	Cubic Feet of Water per Hour.	Boiler Horse Power per Hour.	Steam Pressure Gauge.	Feed Water Temperature Degree F.	Flue Gas Temperature Degrees F.	Remarks.
7:00. ...	8,973	..	..	100	202	390	
8:00 .. .	9,000	87	159	105	202	350	
9:00.....	9,229	169	309	105	210	550	‡
10:00. ...	9,328	99	181	105	198	350	
11:00....	9,426	98	179	110	198	340	
12:00. ...	9,516	90	165	110	200	400	
1:00.....	9,619	103	188	105	198	425	
2:00.....	9,716	97	178	110	198	375	
3:00.....	9,870	154	282	115	208	425	*
4:00.....	9,978	108	198	110	200	400	
Average..	....	111.7	204.3	107.5	201.4	400.5	

Remarks: ‡Carried engine load from 8 to 9. *Carried engine load from 2 to 3. Cleaned fires. 9:30 A.M., 11.15 A.M., 1.30 P.M., 3:20 P.M.

Data and Results.

Date of test	May 8, 1914
Duration of test, hours	9
Kind of furnace	Nicholson grates
Kind of draft	forced
Grate area per boiler, square feet	31.5
Heating surface in boiler, square feet	1,500
Kind of boiler	B. & W. water tube
Size of fuel	coke breeze
Origin	
Total weight fuel as fired, pounds	10,800
Pounds burned per square foot of grate per hour	38.1
Number of cubic feet water fed to boiler	1,005
Nunber of pounds fed to boiler	60,340
Factor of evaporation	1.0523
Pounds water evaporated from and at 212° F	63,490
Steam pressure pounds gauge	107.5
Feed water, degrees F	201.4
Flue gas temperature at damper, degrees F	400
Draft in furnace, inches of water	20
Pressure in ash pit, inches of water	66
Horse power developed on test	204.5
Boiler horse power in service	150
Per cent. rated capacity developed	136.3
Pounds equivalent water evaporated per pound of fuel as fired	5.88
Cost of fuel per ton	$1.75
Cost of evaporating 1,000 lbs. water from and at 212° F., cents	14.8

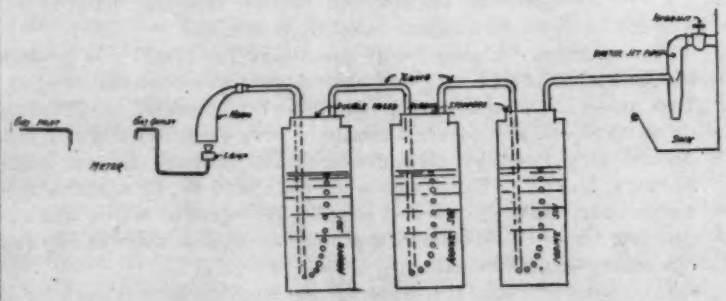
Wrinkles.

[Submitted to the Twenty-Second Annual Convention of the Pacific Coast Gas Association.]

Wrinkle No. 1.—*A. S. B. Little.*—"*How to Keep the Wrinkles Out of Concrete.*"—Gas companies use concrete and cement in larger quantities every year for construction work. There has been great difficulty in protecting the concrete, because it is porous and permits moisture to permeate it. Painting the surface has proved ineffective, because the alkali in the cement saponifies the oil in the paint. In addition, porosity of the cement causes suction, which tends to destroy succeeding coats of paint applied; and the only effective method of stopping suction, and preventing chemical reaction, is to treat the surface of the cement with a solution of zinc sulphate, using sulphate and water in equal parts, by weight—that is 8¼ pounds of zinc sulphate to a gallon of water.

When this is applied to a concrete surface, a reaction takes place between the zinc sulphate and the free lime as deep as the solution penetrates the concrete. The products of this reaction are calcium sulphate and zinc hydroxide, precipitated in the pores of the concrete, two practically insoluble pigments—both neutral. This physically fills the voids and pores, and lessens the suction properties of the concrete, and chemically neutralizes the free lime in the cement. Following this priming coat, after it has had about 96 hours to dry, the surface should be wiped with a brush, and then painted with two coats of a good cement paint containing no linseed oil, but made with a vehicle consisting of good grinding varnish.

Wrinkle No. 2.—*M. J. Dewey.*—*Accurate Method of Determining the amount of Sulphur in a Carbonaceous Substance, either Solid Liquid or Gaseous.*—*For Gases.*—Obtain a standardized solution of iodine which contains a slight amount of KCH. Place a known quantity of this solution into three glass cylinders having dimensions of about 2" dia. by 6" high (the amount of iodine solution should not be over 20 cc. each), then fill the cylinders to within about an inch from the top with distilled water. Connect up with double holed rubber stoppers, glass and rubber tubing as per sketch. Use a gas lamp similar to that used in the Caulkins or Referees Sulphur test, not burning more than 1/6 feet per hour, and a regular laboratory wet meter; being sure that lamp and meter are purged of old gases. Also be sure that you have a dependable water jet pump.



Wrinkle No 2.

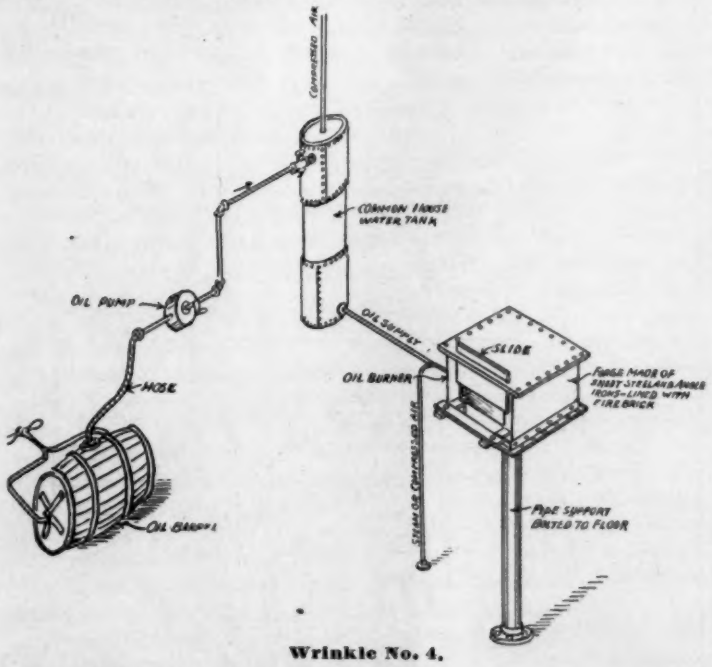
When apparatus is connected, start the jet, seeing that it works steadily, and start lamp burning. When the meter hand arrives at a convenient starting point, place lamp under the glass horn and let run until the color has all left the first cylinder of iodine solution. Stop gas burner, read meter, stop jet. Then standardize a solution of potassium hyposulphate with your standard solution of iodine. Take all the liquid out of the cylinders, saving the rinsings, and titrate with your standardized solution of hypo. The action of the experiment is as follows: 2I plus H20 plus S02 equals 2HI plus S03. For every atom of sulphur consumed in the burner, two atoms of iodine were changed to hydriodic acid, therefore by referring to the atomic weight table you get the exact amount of sulphur in the gas burned. A careful check on this test shows it to be accurate within less than 1 per cent.

Wrinkle No. 3.—*R. P. Valentine.*—As a means of reducing the cost of running services and at the same time avoiding digging up lawns, we hit upon the following scheme: We dig a ditch in the street from the curb out, long enough to take in one length of pipe or say about 20 feet. We then attach a garden hose to the end of service pipe farthest from the curb, the hose connected to a city hydrant. The length of the pipe is then placed in the ditch, set to grade, and end pointed in the direction in which the pipe is to run. Water is then turned on and as it flows from the end of the pipe the service is pushed through the ground until it emerges above ground under the house. It takes 2 men about 10 minutes to run a service 60 or 80 feet under an ordinary lawn. The main is then tapped and the service pipe screwed into the fitting, the water having made a hole around the pipe large enough to allow its being turned without difficulty.

This method of construction is possible because the soil in our vicinity is mostly sand and loam, although there is a little adobe and sand in some places which makes it a little harder to force the pipe. In case we strike tree roots or other impediment we withdraw the pipe and start a new hole, We have been very successful in running services this way, not having had a trapped pipe in 2 years.

Wrinkle No. 4.—*J. F. Creighton.*—"*Homemade Oil Forge.*"—For use in blacksmith shops, it is possible to contrive an oil burner forge which will more than satisfactorily replace a coal forge. One properly constructed, will not only be the means of better and more

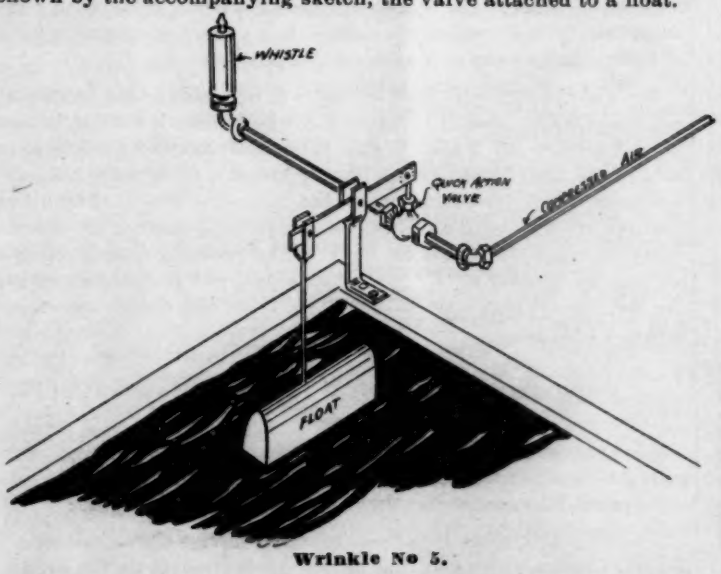
economical operation, but is of further advantage, especially to oil gas plants, where a supply of fuel oil is always at hand.



Wrinkle No. 4.

The sketch shows the design of such a forge that we have installed with good success and at small cost.

Wrinkle No. 5.—*J. W. Creighton.—Alarm for the Approaching Overflow of Reservoir or other Container.*—A very serviceable alarm for warning an operator of approach to the overflow point of a reservoir or other container, is to place a small whistle, in the manner shown by the accompanying sketch, the valve attached to a float.



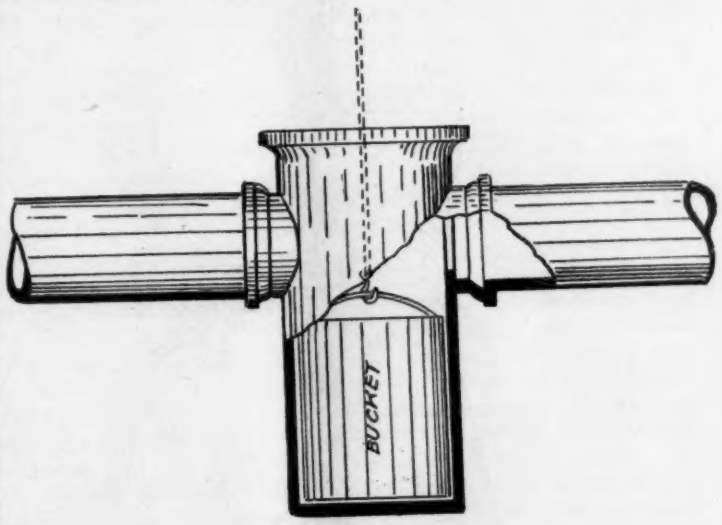
Wrinkle No 5.

The one shown is on a tar water reservoir, which is supplied with a centrifugal pump to take care of its overflow.

Wrinkle No. 6.—*J. F. Creighton.—Cleaning a Relief-Holder Drip Pot Without Putting Holder Out of Commission.*—A galvanized iron bucket, as shown in the attached sketch, is placed in drip pot and supplied with a cable for hoisting when it becomes fouled with drippage. A by-pass is placed between outlet and inlet valves, allowing inlet or outlet to act as either, while the other is shut off at holder valve.

After drip is flooded or sealed, the top is removed and the bucket hoisted out. The bucket is then cleaned and scraped and painted with two coats of either lime or cold water paint on the outside and bottom. This precaution being taken to prevent bucket from becoming fastened to sides or bottom of drip pot, as the lime or cold water paint will pull off from bucket, allowing it to be raised without difficulty.

Wrinkle No. 7.—*J. F. Creighton.—Safety Device for Scrubbers and Washers of Oil and Water Gas Generators while Cleaning.*—Precautions for preventing explosions when putting washboxes and scrubbers of oil and water gas generators out of service are so

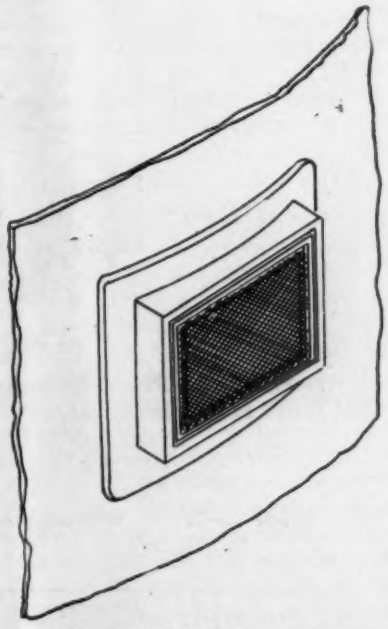


BUCKET IN DRIP POT

Wrinkle No 6.

numerous that hardly any two plants follow like methods. The practice we believe best is as follows: For openings that are vented, whether vent pipe or door opening on top of scrubber, we place in the opening a brass wire cloth of 60 mesh to the inch, the screens made up for scrubber door opening so that they fit tight. For large pipe vents they are made to fit the same as a plug; for small pipe they are in a coupling, 5 or 6 times the diameter of the pipe, one end bushed. When steam is admitted into scrubber or washbox for purging, the screens act as on a miner's lamp.

SCREEN IN WASH BOX VENT



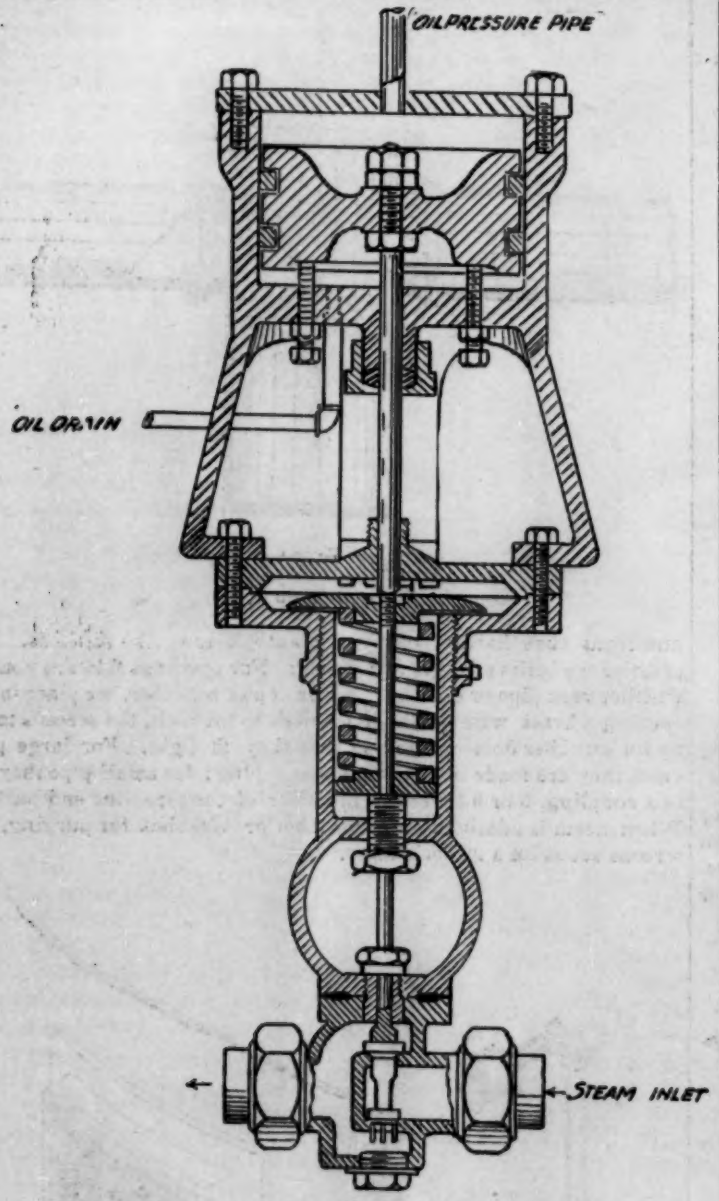
SCREEN IN SCRUBBER MANHOLE

Wrinkle No. 7.

I have seen a small flame on the outside of these screens that would not light back into washbox or scrubber. It is necessary, of course, to keep a small amount of steam vapor passing out through the screen.

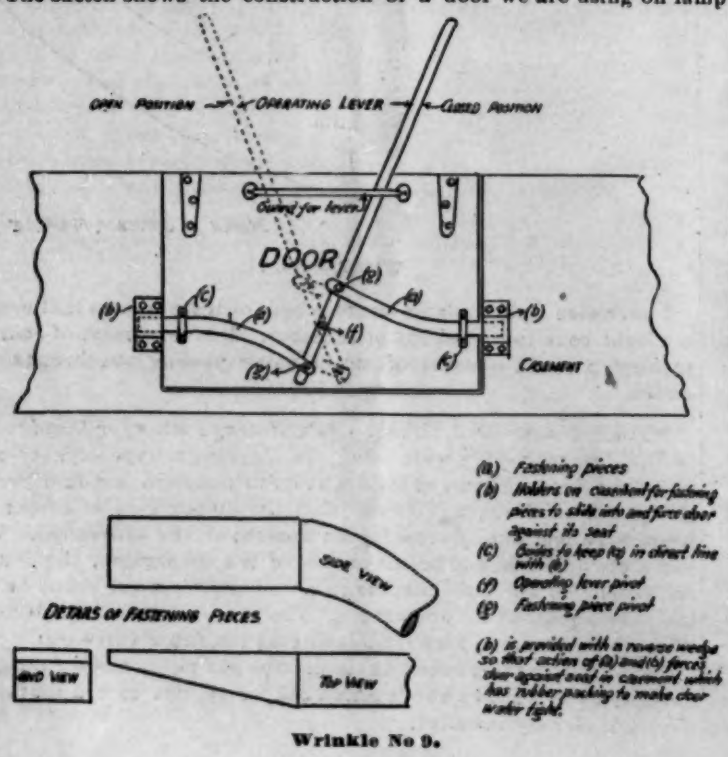
Wrinkle No. 8.—*D. J. Young.—Substituting Piston for Diaphragm in Oil Governor.*—We were using the diaphragm type of governor shown in the lower part of the drawing, to maintain standard pressure on our oil lines, and found that the diaphragms of copper or brass were continually breaking on account of the movement. We had a cylinder cast and bolted on above the diaphragm, the piston rod resting on top of the diaphragm; the diameter of the piston being the same as that of the diaphragm. The two set screws in the bottom of the cylinder are to keep from springing the steam valve seat.

This is nothing more than a combination of a piston and diaphragm governor, but it shows how a piston can be applied to a diaphragm governor already installed.



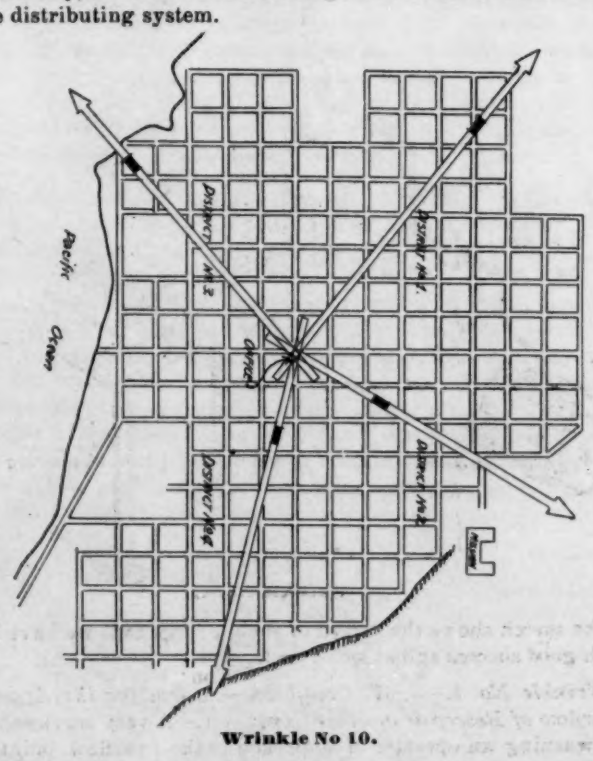
Wrinkle No 8.

Wrinkle No. 9.—*Frank Wilson.—Door for Lamp Black Boxes.*—The sketch shows the construction of a door we are using on lamp black boxes. It has been found very satisfactory and an improvement on anything we have previously used.


OPEN POSITION
OPERATING LEVER
CLOSED POSITION
Guard for lever
DOOR
CASEMENT
SIDE VIEW
DETAILS OF FASTENING PIECES
END VIEW
TOP VIEW
(a) Fastening pieces
(b) Holders on casement for fastening pieces to slide into and force door against its seat
(c) Guides to keep (a) in direct line with (b)
(f) Operating lever pivot
(g) Fastening piece pivot
(b) is provided with a reverse wedge so that action of (a) and (b) forces door against seat in casement which has rubber packing to make door water tight.

Wrinkle No 9.

Wrinkle No 10.—*Frank Wilson.*—This is what is called a dispatchers map, and is used for locating troublemen or others working on the distributing system.



Wrinkle No 10.

The pointers are made of light material, the turning point being at location of office. Each pointer has a different color with a man's name on the end toward the center, and a slide, so that the location of each man or gang of men can be readily seen.

Wrinkle No. 11.—*H. R. Basford.*—A wrinkle for connecting automatic gas water heaters in basement when there is no flue but a flue in the kitchen to which a gas range only is connected, is to cut a hole in the floor close to the chimney breast and directly beneath the flue opening in the chimney in the kitchen. Place in this hole a ventilating flue collar. Run the stove pipe connection from the heater through this hole in back of the gas range, connecting into the pipe by placing a "T" in it so that both the gas range and heater use the flue. Very little of the pipe from the heater shows and it makes a neat job.

Dangers of Mechanical Artificial Respiration.

A committee acting for the U. S. Bureau of Mines has been investigating the subject of resuscitation from asphyxiation, and the mechanical devices in common use therefor, and says in its report:

"No mechanical artificial resuscitating device should be used, unless one operated by hand that has no suction effect on the lungs."

This committee has made the first, and by all signs, the only, scientific study of the pulmotor and other pumping apparatus, their principles of action, and the records on which they are credited with much saving of life. That the committee's verdict will carry everywhere with scientific men is evident from its personnel. No higher authorities on the questions involved could well have been put into a body of five members. The committee was made up of Dr. W. B. Cannon, professor of physiology at Harvard, chairman; Dr. George W. Crile, known the world over for his work on surgical shock and anesthesia; Dr. Joseph Erlanger, professor of physiology at Washington University, St. Louis; Dr. Yandell Henderson, physiology, Yale; and Dr. S. J. Meitzer, head of the department of physiology and pharmacology of the Rockefeller Institute. This is practically the same committee that established the rules for resuscitation after electric shock which can be found posted in power houses all over the civilized world.

Of the reputation of the pulmotor the committee's report says:

"Although years passed after the introduction of this apparatus in Germany, and although Germany has many life-saving societies, no

medical report of its use in a single case has appeared in the very prolific medical literature of that country."

Of the four notices found in American medical literature, the committee says. "In none of these instances is there a careful account of the action of the instrument. And only when an observer publishes his experience in detail, gathered in a number of cases, can we judge whether his observations are unbiased, his statements truthful, and his conclusions justifiable."

Of twenty-one records of gas poisoning in which the pulmotor was reported as having been used with success, put at the committee's disposal by the New York Edison Company, it is said: "Most of the reports were written by chauffeurs and only a few by physicians. In most of the reports no distinction was made between unconsciousness and absence of respiration; and, as already explained, the sensitiveness of the higher centers of the brain to lack of oxygen may result in unconsciousness, while the centers governing respiration may still continue active. Indeed, breathing may persist for some time after the degree of asphyxia is such that death is almest certain to ensue. Only in a few of these twenty-one cases was there reason to assume that breathing might have been suspended. Letters to the various physicians mentioned brought either an unsatisfactory answer, or none at all." A careful study of ten cases reported by miners to the Bureau of Mines, and of twelve cases reported by various physicians, is declared to show a similar lack of foundation for the claims of the pulmotor. The discussion of these cases would probably be convincing even to the lay reader.

"In considering the claims of the pulmotor in the light of the foregoing statements [reports of cases]," says the committee, "it is to be noted that the witnesses of restoration are in many cases merely chauffeurs for the gas company. The pulmotor itself consists of an apparatus for giving artificial respiration, but includes also an arrangement for allowing a subject who is breathing spontaneously to inhale oxygen. * * * However effective the pumps may be as an arrangement for administering artificial respiration, they cannot recall the dead; and, as above pointed out [in an explanation of what gas poisoning is] persons gradually poisoned, in whom respiration has stopped, are dead beyond the possibility of restoration. On the other hand, the oxygen inhaling device of the pulmotor, although it is very simple and involves nothing new in principle, or not found in other apparatus, presents the best possible treatment of victims of gas poisoning who are still breathing—that is, treatment with oxygen. In all probability oxygen and not the pulmotor, however, should have the credit.

"No well-considered testimony to its action is to be found in medical literature, and in this country, at least, its loudest sponsors are the newspapers, which have spread the impression that the pulmotor is a perfect and most reliable resource when respiration is suspended. A high official of one of the important electric companies in the country testified to a member of the committee, 'We have to buy these machines, even if they are no good, as an evidence of our faith and our desire to do everything possible to safeguard the public and employees.'"

The committee has not contented itself with destructive criticism. It evidently felt that the public ought not to be allowed to continue trusting to any apparatus proved unreliable and at times dangerous. Dr. Meltzer, on the constructive side, devised a simple respiration apparatus that is safe, efficient, employs either air or oxygen, and can be used by the layman. Essentially, it is a foot bellows with a tube leading through a finger valve to a metal shape that is to be slipped into the back of the throat so as to cover the entrance to the windpipe. In one position of the valve the air from the bellows passes into the lungs and inflates them; then a slight twist of the finger in the ring of the valve shuts off the inflow of the air, and allows the weight of the chest to expel the air. The action is aided by weighs on the abdomen, or a wide piece of board belted tight over the abdomen, to keep air from entering the stomach, to drive the abdominal blood to the heart and to insure effective expulsion of the air by the weight and elasticity of the chest box. By the use of a mask the same device can be employed to fill the lungs with pure oxygen. Using air, the device can be employed by one person, who works the bellows with his foot, regulates the inflow and escape of air by the finger valve in the rhythm of normal respiration, and can give the needed pressure on the abdomen by pressing against it with his body.

Experiments with the pulmotor were performed on dogs, cats and rabbits, the animals being anesthetized, and also paralyzed by curare. Of 11 dogs, only 1 small animal could be kept alive by means of the automatically working pulmotor for as long as 1 hour. In the majority of the animals respiration could not be kept up even for 5 minutes when left to the automatic activity of the apparatus. Even with hand regulation of the pulmotor, the circulation could rarely be kept in a normal state for longer than 12 to 15 minutes. The lungs gradually became smaller, and were found to be partially collapsed. This was due to the wholly unnatural suction effect. The finer air-passages have no stiffening of cartilage, and under the suction pull these passages collapse, their walls sticking to each other. This greatly reduces the lung volume, and the automatic device of the pulmotor, by which the suction is made operative when there is a slight resistance to the inflow, fails to provide for distending again these collapsed air-passages. This results in an abnormally small "breathing," and long-continued suction may result in serious damage to the structure of the lungs. The pulmotor is operated by small cartridges of oxygen under pressure, the blast of oxygen furnishing the inflating current by acting as an air-pump; when the lungs oppose a slight resistance to the inflow the oxygen blast operates a switch which makes the blast pump out of the lungs instead of into them.

By contrast, the Meltzer device has been tested with air alone, and with pure oxygen, by keeping numerous animals alive for many hours while under the exacting conditions of curare and ether, and of opened chest wall to permit observation of the lungs.

The committee recommends Dr. Meltzer's apparatus for these good features:

1. Its positive action is determined by the operators and not left to a mechanism which may fail to operate.
2. It is free from a sucking action during expiration—expiration results from the natural recoil of the disturbed parts.
3. It is light.
4. It is relatively inexpensive.
5. It is simple.
6. It may deliver pure oxygen—a possibly important consideration in gas cases.
7. It embodies in a form that can be used by laymen a principle of artificial respiration that has been employed for many years in scores of laboratories and on thousands of animals, and is known to be effective and free from danger. These are virtues that stand out prominently at points where present commercial devices are in fact most defective.

New Methods and Appliances.

THE STRENGTH OF OXY-ACETYLENE WELDS.—A conference of shipbuilders and engineers recently brought forth a paper by Prof. A. Campion and Wm. C. Grey on the results of tensile and impact tests of oxy-Acetylene welds. The authors remarked that under working conditions the material was usually subjected to repeated shocks; and they had, in addtion to static tests, compared the effects of repeated impact on welded and unwelded metal. The material used was mild steel, containing about 0.25 per cent. of carbon. For the first series bars $\frac{5}{8}$ inch in diameter were turned down for a length of $1\frac{1}{2}$ inches at the weld to $\frac{1}{2}$ inch in diameter, the elongation being taken on a 1-inch length. Contraction of area was not recorded because most of the fractures were too ragged to allow of measurement. The results indicated that an average weld had about four-fifths of of the strength of unwelded steel, while the ductility is only about one-fifth. There was no great variation in maximum tensile strength, but ductility varied widely from the average; for, the lowest strength of welded metal was about 80 per cent. of that of the original steel, and the lowest elongation was only 9 per cent. Ductility was increased by hammering; but the strength was lowered. Reheating after hammering improved both the ductility and the maximum stress. Reheating at the same temperature without hammering caused a comparatively large rise in ductility and a small rise in the strength. Quencing in water and reheating brought the strength up almost to that of the unwelded steel, but diminished the elongation.

For the impact tests bars $6\frac{1}{2}$ inches long and $\frac{1}{2}$ inch in diameter were notched in the center of the welded part to a diameter of 0.4 inches. The results showed great variation, and suggested that an average weld would resist only half as much fatigue as unwelded metal. Hammering improves the weld in this respect, but the metal should be reheated at a full red heat—800° C.—to avoid production of strains or brittleness. Reheating or annealing without hammering has but little effect. The treatment which produced the best results in the tensile tests gave the worst in the impact tests. Fur-

ther experiments with the bars notched at the edge of the weld instead of at the center, were made to ascertain the influence on the whole weld of the overheated zone produced during welding, and the results varied still more than those given by centrally notched bars; but while hammering specimens of the latter gave 84.4 per cent. of the original strength, the hammered side-notched bars gave only 57.7 per cent. Impact tests on plates of different thicknesses showed conclusively that the reliability of the weld and the strength decreased as the thickness increased.

The authors conclude that very serious responsibility is incurred by using autogenous welding in parts which may be subjected to any considerable strain.

A NEW BEARING METAL.—An account of a new alloy for bearings appears in *The Engineer*. It is composed of 65 parts of copper, 30 of lead and 5 of tin. It was tested on the bearings of a tender of a Pacific type locomotive for 50,000 miles, after which it showed wear of but $\frac{1}{32}$ inch, while the other bearings, of white metal, had to be renewed 6 times. In other applications it proved twice as durable as phosphor bronze.

Recent Patent Issues.

Prepared for the AMERICAN GAS LIGHT JOURNAL by ROYAL E. BURNHAM, solicitor of patents and counselor in patent causes, 833 Bond Building, Washington, D. C., from whom illustrations and specifications of any patent mentioned below may be obtained for 20 cents.

1,112,176. Gas Burner Cleaner. H. van Hoevenberg, North Elba, N. Y.

1,112,355. Automatic Burner for Gas Stoves. G. Bruton, Joliet, Ills., assignor to F. L. Rockey, same place.

1,112,381. Gas Washer. J. F. M. Patitz, Milwaukee, Wis., assignor, by means of assignments, to Allis-Chalmers Mfg. Co.

1,112,484. Gas Heated Water Heater. J. Shimmelfennig, Philadelphia, Pa., assignor of two thirds to W. F. Groll, West Philadelphia, Pa.

1,112,529. Water Heater. E. W. Evans, Robinson, Ills.

1,112,534. Gas Producer Apparatus. J. A. Herrick, Newark, N. J.

1,112,597. Gas Generator. C. J. Clefton, Owatonna, Minn., assignor to The Clefton Co., same place.

1,112,702. Gas Producer. E. A. W. Jeffries and G. H. Insley, Worcester, Mass., assignors to the Morgan Engineering Co., same place.

1,112,707. Automatic Gas Controller. H. G. Krager, Lestershire, N. Y.

1,112,797. Gas and Oil Burner. W.A. Hines, W. J. Curry, J. D. Miskelly, and S. A. Marshall, New Cumberland, W. Va.; said Marshall assignor to W. A. Andrews, East Liverpool, O.

1,112,862. Bunsen Burner. O. Spahr and L. J. Strauss, Philadelphia, Pa,, assignor to Strauss Gas Iron Co., same place.

1,112,970. Apparatus for Purifying Gases. K. Bombard, Berlin, Germany.

1,112,977. Closure Locking Means for Gas Retorts. H. A. Carpenter and A. W. Warner, Sewickley, Pa., assignors to Riter-Conley Mfg. Co., Pittsburgh, Pa.

1,112,978, Means for Controlling the Operation of Gas Retorts. H. A. Carpenter and W. Warner, Sewickley, Pa., assignors to Riter-Conley Mfg. Co., Pittsburgh, Pa.

1,113,076. Safety Gas Burner. D. J. Wallace, U. S. Navy.

1,113,326. Combined Supplemental Gas Reservoir and Burner. J. M. Gilbert, Dallas, Tex.

1,113,339. Gas Burner. W. Hawkes, Duluth, Minn., assignor to Hugo Mfg. Co., same place.

1,113,379. Gas and Coal Burning Furnace. C. R. Stedman, Cleveland, O.

1,113,437. Method of Separating Moisture from Burner Gases. J. B. F. Herrshoff, New York city, assignor to General Chemical Co., same place.

1,113,498. Lighting Device for Oven Burners. J. F. Skoog, Erie, Pa., assignor to Erie Stove and Mfg. Co., same place.

1,113,682. Gas Desication. J. F. M. Patitz, Milwaukee, Wis., asignor, by means assignment, to Allis-Chalmers Mfg. Co.

1,113,685. Automatic Gas Cock. R. M. G. Phillips, New Haven, Conn., assignor to The Sentinal Automatic Gas Appliance Co., same place.

1,113,862. Gas Fixture. J. T. Baker, Baltimore, Md.

Items of Interest
FROM VARIOUS LOCALITIES.

PHILMER EVES, ex-Secretary of the Indiana Gas Association, who resigned his position as Sales Manager with the Indianapolis Gas Company, on the consolidation of that company with the Citizens Gas Company, has just returned from a 6 months' trip with Mrs. Eves and their infant son to Scotland and England. On the outbreak of the war, Mr. Eves was at his father-in-law's farm, on the shore of the North Sea, in the far north of Scotland, and heard some of the early cannonading off the Orkney Islands, and witnessed the mobilization of the territorial regiments of the army. The departure of the soldiers from northern counties of Scotland left the farms, in many cases, with few men to gather the crops, and the work was being done mostly by the peasant women. Although return tickets had been obtained before leaving New York it was with extreme difficulty that Mr. Eves managed to get back, but he and his family finally secured passage on an Anchor Line steamer sailing from Glasgow. They experienced an eventful and a stormy voyage. All their baggage, however, was saved and sent on to the home of relatives in Paterson, N. J., where Mr. Eves remained in order to be present at the meeting of the American Gas Institute. While in Europe he studied the commercial methods of several large gas companies and speaks warmly of the respect and admiration that is felt over there for the gas associations and gas progress in this country. Mr. Eves is now seeking to locate a gas company requiring the services of an experienced and successful new business manager. His splendid record in Indianapolis, Ind., and formerly in Paterson, N. J., is sufficient evidence of his high qualifications and the JOURNAL hopes that he will very soon be found in harness again.

EDUCATIONAL trips to manufacturing establishments of Springfield, Mass., will be an important part of the Y. M. C. A. boys' department program this season. The first of the trips was taken to the gas plant, where 15 boys went through the plant, under the leadership of the assistant boys' work director, C. Courtland Turner, guided by the manager of the plant. The next trip will be to the Municipal Water Tower and to the York Street Jail.

MR. G. W. BRIGGS, formerly Manager of the Mt. Clemens Gas Light Company, a subsidiary of the American Public Utilities Company, has been appointed General Manager of the Albion (Mich.) Gas Light Company, to succeed Mr. C. H. Broom, resigned. Mr. Roderick I. Speer has been appointed General Manager of the Mt. Clemens Gas Light Company, succeeding Mr. Briggs.

THE extent to which foreign capital could be brought to the United States to develop the public utility industry was for many years a matter of large interest in the financial markets. Figures just made show how fully one-half the shareholders of such an important utility company as the Consolidated Gas, Electric Light and Power Company, of Baltimore, are European. This company has 2,384 shareholders registered on its books on October 1, of whom 1,165 were foreigners.

A NEW franchise has been granted to Henry F. Cook, of the Sag Harbor Gas Co., of Southampton, Long Island, by the Town Board, which gives him the privilege to install, acquire, lease, operate and maintain lines of pipe through the streets and public highways of the town of Southampton for the purpose of distributing and supplying gas for public and private use.

THE Public Service Gas Company has presented a new form of street lighting contract to the Morris township, N. J., committee for consideration. The committee has decided to advertise that it will consider the contract at its next meeting. The township has been paying for street lamps at the rate of $28 apiece for up to 50 light and $27 apiece for 50 or more. The new contract fixes the rate at $26 up to 50 and $25 for more than 50. Under the old contract the committee expended last year $1,628.25.

A. M. WINTHROW and F. E. Rail, business men of Geneseo, Ills., are circulating a petition to the City Council for a municipal electric light and gas plant to succeed the Illinois Northern Utilitis Company when its franchise expires in 1917.

AT the annual meeting of the Massachusetts Gas Companies Robert Winsor, C. Minot Weld, Charles A. Stone, James L. Richards and Frederick E. Snow were re-elected trustees for a 2-year term.

IN describing the attack of the Germans on Antwerp, the correspondent of the "Daily Telegraph," writing from Antwerp, says: "From the top of a gas tank at Hoboken (three miles southwest of Antwerp) was witnessed a scene of somber grandeur. The line of attack on the city was defined in the clear night air very sharply by flashes from the enemy's great siege guns. Similarity, the line of the defense was shown in points of light which stabbed the night from the Belgian forts. It was almost possible occasionally to see the effect of the falling shells."

"P. E.," WRITING from Rochester, N. Y., says that the Rochester Railway and Light Company has begun the re-caulking of its 20-mile equilizing gas mains, using lead-wool in the joints and pneumatic caulking tools. These mains circle the city like the rim of a giant wheel, joining the distributing mains far from the gas holder and supplementing the gas supply.

RECEIVER TRELEAVEN urges the people of Topeka, Kas., to buy coal, and while buying buy a-plenty, as he believes that the supply of natural gas for the coming winter will be even less than last winter. However, it is believed that the local gas company will be able to supply at least enough to make the meters go round. The receivers for the Kansas Natural Gas Company, from whom the Topeka company procures its supply, recently issued a statement to the effect that Kansas would receive no greater amount of gas this year than last.

PROCEEDINGS by the city against the Binghamton (N. Y.) Gas Company in an effort to reduce the price of gas in that city, which have been going on through the Public Service Commission, will be discontinued. The Common Council has passed an ordinance directing that the proceedings be discontinued until October 1, 1915. Just how this understanding was reached is not known, but the city will not proceed for 1 year at least. It is understood that several of the larger industries of the city have stopped their use of gas because of a dull season, caused by the poor condition of the market and the general reverses brought on by the war. Thus, it is understood the gas company will find it impossible even to compromise with the city until conditions better themselves.

GAS has been turned on in Alma, Mich., by the Gratoit County Gas Company, and the company is making a fine display of lights, and demonstrating appliances. The piping in Ithaca and St. Louis has been started and will be completed as soon as possible, and then these two towns will have an equal chance with Alma in using gas.

OMAHA, NEB., cannot for the present have dollar gas, according to a decision handed down by Federal Judge T. C. Munger, in the case wherein the Omaha Gas Company asked for an injunction forbidding the enforcement of the dollar gas ordinance. The judge holds that the 25-year contract of 1893 in which the city agreed to a rate of $1.25 per 1,000 feet cannot be broken. The city, therefore, if it abides by the decision, cannot reduce the price until the term of the present contract expires.

THE Columbus Gas Construction Company has made plans for the erection of a retort house and office building, including show rooms, to be built at Little Falls, Minn., for the Little Falls Darling Gas Company.

BEGINNING September 1st, Beasdstown, Ill., gas consumers are paying 10 per cent. less than heretofore. All bills rendered October 1st being subject to a 20 per cent. cash discount instead of 10 per cent. as in the past. The reduction means a gas rate of $1.08 net, whereas it was $1.21¼ prior to September 1st. Under the terms of the gas franchise the decrease of the rate was to take effect in August, 1916, but through the efforts of Mayor Keil, at the time the Central Illinois Public Service Company wanted an electric franchise it was arranged that the additional 10 per cent. discount should become operative in 1914.

MR. JAMES C. ERNST has retired from active management of the South Covington and Cincinnati Street Railway Company and the Union Light, Heat and Power Company, of which he is the President, and from the associate management of the Columbia Gas and Electric Company and the Union Gas and Electric Company, of both of which he is the First Vice-President, in answer to the demands of his health and upon the advice of physicians who have unceasingly urged him for the past several years to give up the more exacting of his many positions.

AT the annual meeting of the Easthampton Gas Company the following officers were elected: President, Philip Cabot; Vice-President, Henry S. Thompson; Treasurer, Lester E. Flint, of Boston; Assistant Treasurer and Secretary, John N. Lyman, of Easthampton; Directors, Philip Cabot, Henry T. Thompson, Lester E. Flint, Joseph W. Stephens of Greenfield, Charles W. Hazelton of Turners Falls Horace L. Clark, Charles H. Johnson, Winslow H. Edwards and John N. Lyman of Easthampton.

THE Central Illinois Light Company is asking for a franchise allowing them to extend their gas mains in Bartonville. The plan is to extend the main through Bartonville and on to Pekin. The Bartonville board is willing to allow the franchise if reasonable terms can be made.

THE new 5,000,000 cubic foot holder of the New Orleans (La.) Railway and Light Company is almost ready to be put in service.

THE Roanoke (Va.) Gas Light Company has installed at the corner Eleventh avenue and Roanoke street, a gas lighted street marker, which is attracting some attention, and which has been viewed by the council committee on lights. The lamp and mountings are similar to those used for street signs in a number of cities. While the marker is not designed for lighting purposes, it, nevertheless, would be of considerable value as an illuminant at places where arc lights have not been placed. The gas company hopes to have the council decide as to the advisability of placing the street markers generally. The signs are so placed that they are illuminated at night and prominent enough to be noticeable by day.

WORK on the construction of the Pacific Gas and Electric Company's gas holder in San Jose, Cal., was begun last week. Duncanson & Harrelson, of San Francisco, are the contractors. The container will be 100 feet in diameter and 96 feet high, on a foundation of concrete.

MR. E. T. THOMAS who has been Secretary and Assistant Treasurer of the Abilene (Tex.) Gas and Electric Company for the past 8 years, has resigned and will leave Abilene November 1st for Memphis, Tex., where he goes to become manager of the Memphis Ice and Electric Company.

"J. P. S.," New Ulm, Minn., says that gas will be supplied to several hundred houses there this week, the generators at the company's plant are in readiness, as for several days a constant fire has been maintained to give the heating compartments a chance to dry out before the plant is actually placed in operation. With the exception of a few minor details the entire plant is ready to manufacture gas. Over 300 gas connections have been made in the city during the past few weeks. At the present time a large crew of men is making additional connections and from now until winter sets in several hundred more homes will be piped and equipped.

AT the first fall meeting of the Pittsfield (Mass.) Coal Gas Company Employees' Association, in the clubrooms on South street, a large amount of routine business was transacted. The association has organized an outing club similar to those conducted by local banks and which has as its object the accumulation of funds for a trip to Boston next year. The plan of operation provides for the payment of a specified sum of money each week to the treasurer of the association by each member. At the end of the club period the money deposited will be refunded to the members. The association has also voted to start a circulating library of magazines relating to the gas business. A discussion of the subject "A New Gas Burner" was a feature of the meeting. Two new semi-indirect fixtures were installed in the club rooms for the purpose of demonstrating the burner. A collation was served during the evening by the refreshment committee of the association.

Utilities Commission News.

WESTERN STATES NOTES.—The application of the Western States Gas and Electric Company to issue $731,000 3-year 6 per cent. promissory notes has been approved by the California Railroad Commission. Disposal of the notes must be made at not less than 92½, and the proceeds will be used to finance floating indebtedness amounting to $540,386, and the remainder for improvements to the company's property.

COLORADO COMMISSION.—A statement concerning the public utilities law which has become effective has been issued by the Public Utilities Commission of Colorado. The commission expresses the hope that its effort will meet with the approval of the public and will result in bringing the people, and the utility corporations of the State into closer and more harmonious relations, to the lasting and enduring benefit of all.

MAY SELL BONDS AT 80.—The Ohio Commission has granted permission to the Massillon Electric and Gas Company to issue $118,000 of 5 per cent. first mortgage bonds at 80. The company told the commission that the poor condition of the market prevented it from selling the bonds at par. Permission had been given on August 24 for the issue, but at that time the condition was attached that the bonds must be sold at par.

UTILITIES COMMISSION FOR UTAH.—Plans favoring the creation of a public utilities commission for the State of Utah were included in the platforms of the Democratic and Progressive parties which recently held their State conventions in Salt Lake City. The two parties have fused in Utah, naming a ticket including half Democrats and half members of the Progressive party. Both conventions unanimously adopted the public utilities plank, and the two parties promise that if the combined ticket is elected next fall a public utilities commission will be created. The question of a creation of a public utilities commission has been considered by the Utah Legislature several times, but bills providing for a commission have always been killed.

WESTCHESTER LIGHTING CASES.—The up State (New York) Public Service Commission has ordered a reargument of the long pending Westchester Lighting cases before it on Thursday, October 29, at Albany. As the cases stand at present a mass of testimony is before the commission so voluminous as to make it practically impossible for anyone to come to a decision in these cases with only the testimony to guide him. It would be a labor literally of months to merely read the testimony. The reargument announced does not contemplate the addition of anything to this record, but is rather, for the benefit of those members of the Commission appointed since testimony in the case was closed. The various parties will be given an opportunity merely to summarize their testimony and arguments. In this way the entire Commission will get a comprehensive view of the problems presented in as brief a time as possible in a case of large importance to the residents of Westchester County, and one in which hearing after hearing has piled up in a way that promised no end. The cases, all against the Westchester Lighting Company, have been consolidated into one and include the complaints as to the quality and price of gas and electricity by the residents of White Plains and Portchester, complaint of Eastchester as to the price of gas and service, complaint of the residents of Tarrytown and North Tarrytown as to the price of electricity and the quality of gas, and the price and service of electricity, and of the residents of Irvington as to the quality of gas, the price of electricity and electric service.

WEST VIRGINIA ACCIDENT REPORTS.—During the month of August, 1,225 accidents involving claims against the workmen's compensation fund were reported to the West Virginia Public Service Commission. Of these claims and of a large number before unsettled, 1,215 were paid in full and partial payments were made on 312 claims. Compensation was denied on 451 claims. In the same period thirty-two fatal accidents were reported, twenty-six being from the mining industry. one from the iron and steel industries, two from public utilities and three from general contracting operations.

Financial Notes.

As trustee for certain bondholders of the Dover, Rockaway and Port Oram (N. J.) Gas Company, the Fidelity Trust Company, of Newark, has instituted proceedings for the foreclosure of a $90,000 mortgage on the corporation's property. In a bill filed, the Fidelity sets forth that the gas company has defaulted in three semi-annual payments of interest on the bonds in question, and that the present proceedings are instituted in obedience to the action of the majority of the bondholders. The mortgage given to secure the payment of 90 bonds of $1,000 each is subject to a prior mortgage of $100,000, which is designed to secure other bonds, and it is followed by another mortgage for $500,000 held by the Fidelity, as trustee, for still other bondholders. The mortgage under which the foreclosure is proposed covers the gas company's property in Dover and the township of Randolph, Morris County, as well as all other real estate, buildings, machinery, gas mains and patents.

A STRONG demand is reported for Peoples (Chicago) Gas shares and sales were announced at 108. The stock closed at 106 July 30, and there has since been a dividend of 2 per cent. deducted from that price. It is said that earnings are holding a substantial gain over last year.

STOCKHOLDERS of the Atlantic Gas and Electric Company are in receipt of a circular from Thomas C. Perkins, of Hartfort, Conn., explaining the events which led up to the receivership. Meikleham & Dinsmore, the bankers and engineers for the company, according to the circular, were under agreement with the company to take from it and pay cash for such stock, bonds and other securities of the company issued from time to time to provide funds for development and extension work on the underlying companies. Meikleham & Dinsmore borrowed approximately $1,000,000, secured by securities which they had bought from the Atlantic company, anticipating the sale and distribution of these securities by themselves to investors. When the tightening in the money market occurred some of the large banks holding the firms paper called a meeting and appointed a committee which stopped Meikleham & Dinsmore from selling any more securities or negotiating loans. This prevented the company's agent from purchasing its securities, as per the agreement, and left the company without bankers. The company had completed and paid for about $1,000,000 worth of construction at Boonton N. J. and Easton, Pa., and but from $300,000 to $100,000 was required to finish the work, the earnings which would accrue being such that the expenditure was considered a good investment. With its avenue of finance closed it was necessary to seek other sources, and Stone & Webster were retained and an audit made which substantiated the belief that the company will ultimately be successful. At present negotiations are under way to provide the company with funds and place it on a sound basis, but as a few of the smaller creditors were insistent, a temporary receivership became necessary.

THE 11th annual report of the Massachusetts Gas Companies for the year ended June 30, 1914, shows surplus, after preferred dividends, of $1,381,149, equivalent to 5½ per cent. on the 250,000 common shares, against 6.07 per cent. previous year.

The income account compares as follows:

	1914.	1913.	1912.
Interest	$449,334	$420,907	$324,331
Divs. rec'd	2,368,025	2,386,318	2,198,049
Prof. sale sec.....	1,207	750	550
Total	2,818,567	2,807,975	2,522,930
Expenses.....	88,218	66,388	66,197
Interest	441,767	440,018	370,567
P'f'd. divs..	1,000,000	1,000,000	370,567
Res. dep. sec.....	1,207	.....	.....
Surplus.....	1,287,374	1,301,506	1,086,164

The undivided earnings of constituent companies compare as follows:

	1914.	1913.	1912.
NEC & C Co	$10,253	$2,427	$43,237
NEC & Coke	14,789	†102,663	5,217
Boston.....	‡53,090	62,068	*14,667
Fed. Coal Co.....	19,094	22,374	5,760
Newton.....	*1,541	11,891	10,752
East Boston.....	3,311	8,452	5,445
Quincy.....	3,347	3,460	2,735
Bos. Tow B. Co.....	1,430	3,036	6,748
Total	103,775	216,383	65,230

* Deficit. † Not including $31,918 of the J. B. B. Coal Co., controlled by New England Coal & Coke Co., through ownership of 2,000 shares, of approximately 60 per cent. of capital. ‡ Not including amount charged to profit and loss account $636, same being loss on real estate sold during the year.